The New Zealand
Journal of Agriculture.

VOL. 42. WELLINGTON, 20TH MAY, 1931. No. 5.

SPARTINA-GRASS AND TIDAL MUD-FLAT RECLAMATION.

SOME RECENT OBSERVATIONS IN EUROPE.

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IN the November, 1929, number of this *Journal* I gave a summary of the published accounts of *Spartina Townsendii* as it occurs in England and Europe, where its spectacular spread over estuarine muds has been spoken of by Professor F. W. Oliver as "a botanical phenomenon of the first order, perhaps unique in the recorded history of vegetation." As I was able to visit the more important Spartina areas in August, 1930, a few further remarks may be of interest. I am greatly indebted to Professor F. W. Oliver, Dr. J. P. Lotsy, and Messrs. J. Bryce and A. G. Verhoeven for their companionship and guidance during these excursions.

Before the advent of Spartina the estuarine shores presented at low tide a vast expanse of mud bordered by narrow breadths of salt-marsh or "saltings," often with an abrupt bank between the seaward edge and the bare muds, with numerous drainage channels meandering through them. All the saltings seen by me were dominated by the sea-aster, which gave to them a pleasant meadowy appearance. At my visit they were gay with the abundance of purple or occasionally yellow flowers of the aster. Mingled with the aster were more or less of *Glyceria maritima*, a low-growing grass, sea-pink, sea-lavender, and sea-suaeda. On the seaward margin the pioneer plants of the mud were glasswort and sea-grass, while on the landward the marshes merged by way of a small rush (*Juncus Gerardi*), bent-grass, and a coastal form of couch-grass into the coastal grasslands. Along the drainage channels the sea-purslane was very prominent, while occasional patches of cord-grass (*Spartina stricta*) were generally to be found. These salt-marsh plants are unable to establish on the softer muds, so that natural reclamation is an exceedingly slow process. With the incoming of *Spartina Townsendii*, however, whether naturally or by planting, a most wonderful transformation occurs. Thanks partly

to its power of rapid-rooting, this plant rapidly takes hold even of the softest muds and grows luxuriantly. The result is that in a few years great meadows have formed on what have been for centuries bare unexploitable muds.

Visits in England.

I visited Poole Harbour, the classical locality, in company with Professor Oliver. The first specimen here found was noted in 1899. The subsequent history is strikingly recorded in a series of photographs taken by Professor Oliver. In 1911 scattered luxuriant bunches of the grass could be found all over the higher mud-flats. By 1924 these had united together, leaving only the drainage channels free, and had extended their hold toward the deeper waters of the harbour. At my visit every bay and inlet had its Spartina cover, and gave the appearance of great wheat-fields. As the entrance to Poole Harbour is narrow, and as the Spartina growth, with the consequent raising of the mud-level, must have reduced enormously the storage space for tidal water, there is now here to hand the opportunity of finding the solution of the much-debated problem as to what the effect of Spartina will be on the navigability of such estuarine harbours. At Southampton Water the position appeared to be similar, if a little less spectacular. The Spartina appeared able to establish, although in a less vigorous way, even on the shallower harder muds. At both localities there seemed good evidence that Spartina is able to establish in and dominate the sea-aster communities, but not to extend into the higher areas occupied by the rushes. This tallies with the observations I have made at Foxton on the relation between Spartina and *Juncus maritimus*, when they come into competition.

The experiments on the Essex coast were demonstrated to me by Mr. J. Bryce, Director of the East Anglian Institute of Agriculture, who has been the prime mover in the work here. In 1925 experiments were commenced at Northey Island, near the head of the estuary of the Blackwater River. The sea-wall enclosing the island has been in a state of disrepair for many years, and at my visit there were still numerous wide breaches by which the tidal waters entered. We especially studied an area of 200 acres that is completely flooded at spring tides and has reverted to a sea-aster community. Two successful plantings of Spartina were made, one inside and one outside the wall. The outer planting is subject to much tidal wash and is only slowly doing its work, but the inner planting has done very well indeed, and is extending its own area both vegetatively and by seedlings. The hopes for the bringing-back into profit of these 200 acres seemed very bright. The other plantings in the Blackwater area that I saw were not doing nearly so well. Here rows of clumps of the grass had been planted parallel to the shore, the operations commencing in 1926. As I saw then the clumps appeared to be doing little more than holding their own. There is a strong current and heavy wash, which is certainly a contributing factor, but it would also appear that the climatic conditions are less favourable than along the south coast. However this may be, the experiments deserve full support and from the experience gained the difficulties may be surmounted. Owing

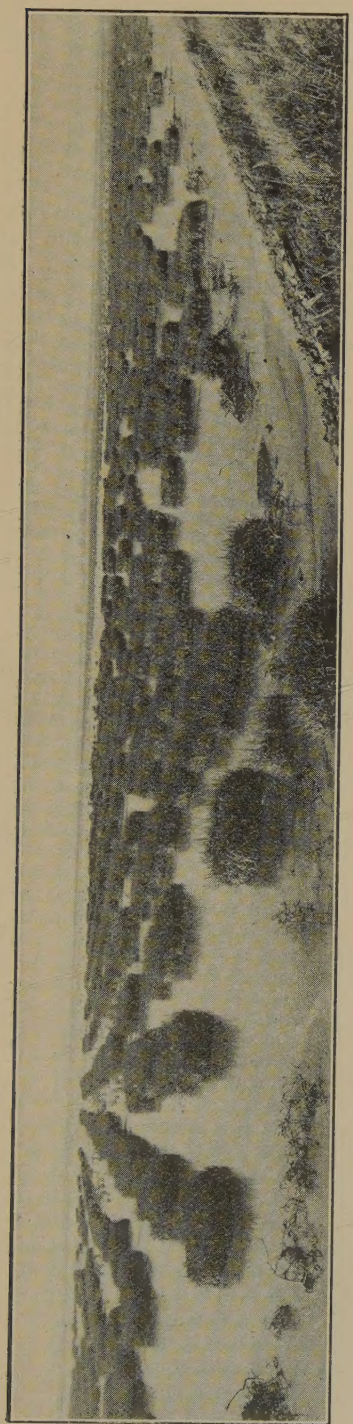

FIG. 1. PLANTATION OF SPARTINA TOWNSENDII ON THE MUD-FLATS OF THE SLOE, HOLLAND, PHOTOGRAPHED IN 1928.

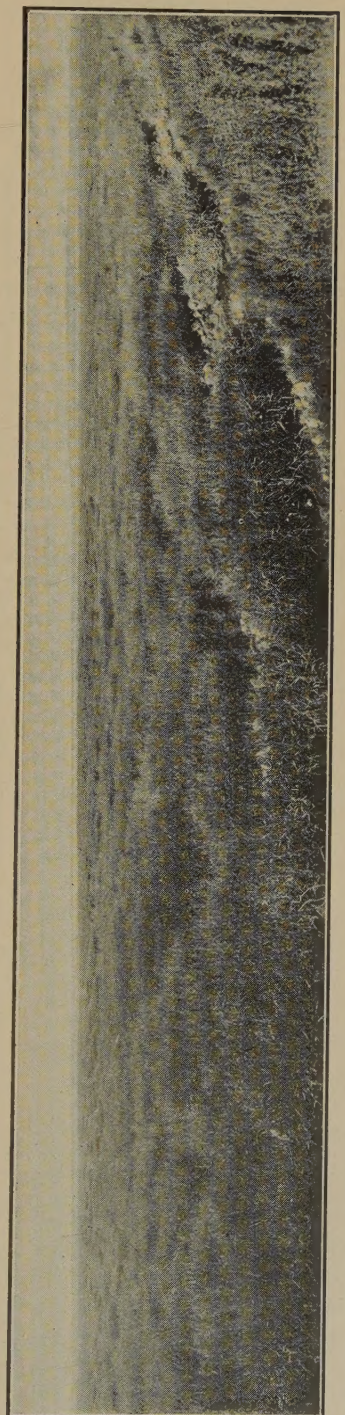

FIG. 2. THE SAME PLANTATION PHOTOGRAPHED IN 1930.

[*Photos by F. W. Oliver.*

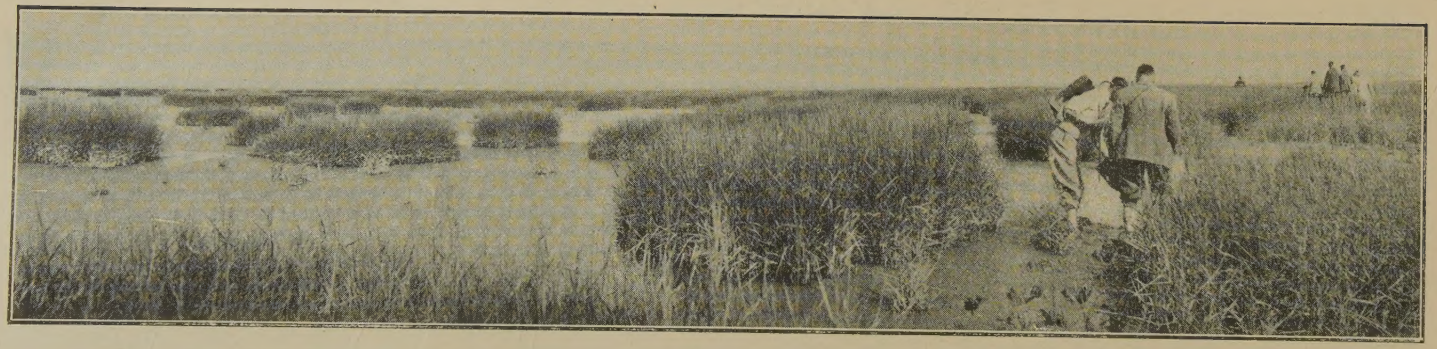

FIG. 3. A LATER PLANTING IN THE SLOE AREA, SHOWING VIGOUR OF CLUMPS AND INCOMING OF SEEDLINGS.

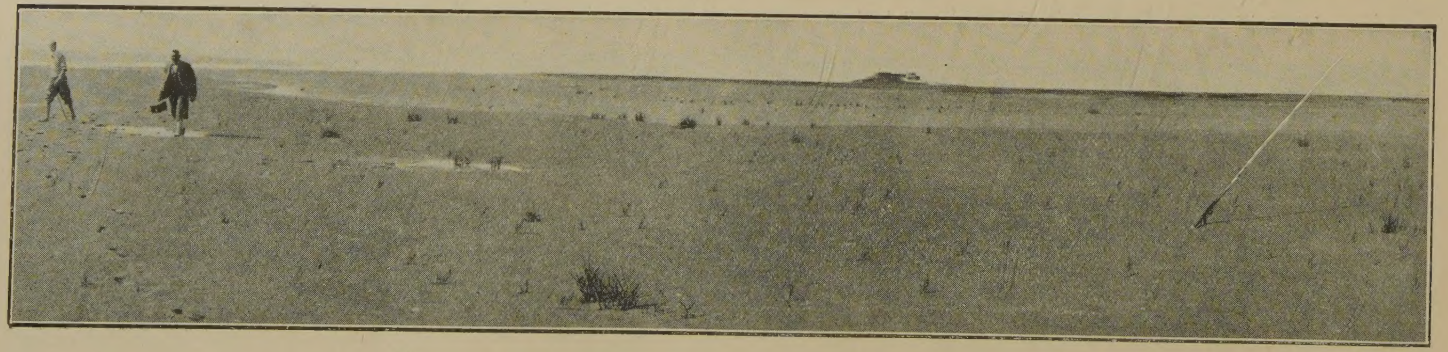

FIG. 4. THE SLOE MUD-FLATS BEFORE THE ADVENT OF SPARTINA. *[Photos by F. W. Oliver (1930)*

A few naturally established clumps of Spartina are observable.

to the great importance of the sea-walls on this coast, and the cost and trouble of maintaining them, the successful establishment of Spartina would prove of the greatest benefit.

Experience in Holland.

The experiments in Holland were commenced owing to the insistence of Dr. Lotsy, who had been greatly impressed by what he had seen at Poole Harbour. They have been highly successful owing to the energy and skilful technique of Mr. A. G. Verhoeven, maritime engineer in charge of reclamation work in Zeeland. Indeed, they can hardly be called experiments. Mr. Verhoeven was so impressed with the capabilities of Spartina that he went straight at his objective with a success that is as pleasing as it is remarkable. "As a result of a detailed survey of Spartina localities," says Oliver, "a first batch of fifty cuttings went to Holland and subsequently tens of thousands." Writing in 1928, Oliver stated: "These plantations have reached an impressive phase. The Spartina cuttings are mostly planted in the muds at three-meter intervals, and have made three, and sometimes four years' growth—such plants averaging 6 to 7 feet across. By 1930 the units should meet to form continuous meadow." (Fig. 1.) That this was a true prophecy will be seen from the photograph taken in 1930 during my visit (Fig. 2). The meadowing has been hastened by free seeding, as is shown in a photograph of a later planting (Fig. 3).

What this meadowing by Spartina means in the economy of the mud-flats in Holland may be seen from the photograph (Fig. 4) of typical muds as unaided nature deals with them. But even here natural establishment of Spartina may be seen to be commencing. Not only does Spartina establish in such a quick and thoroughgoing way, but it also enables the ordinary salt-marsh plants to establish and aid in the consolidation From a reclamation point of view the result may best be given in Mr. Verhoeven's statement, that Spartina has proved that it can hasten impoldering by ten years.

SHEEP FLOCKS IN NEW ZEALAND.

Size of Flock.	Number of Flocks.		Number of Sheep.	
	1929.	1930.	1929.	1930.
1–200	5,551	7,100	541,029	667,335
201–500	6,364	7,184	2,164,578	2,435,173
501–1,000	6,313	6,764	4,560,316	4,879,290
1,001–2,500	5,975	6,318	9,177,819	9,680,159
2,501–5,000	1,724	1,860	5,910,407	6,334,184
5,001–7,500	440	456	2,654,060	2,796,325
7,501–10,000 ..	173	159	1,515,056	1,351,128
10,001–20,000 ..	146	151	1,893,639	1,942,187
20,001 and over ..	26	30	634,478	755,506
Totals ..	26,712	30,022	29,051,382	30,841,287

PULPY KIDNEY DISEASE OF LAMBS.

NOTES ON INVESTIGATIONAL WORK IN 1930 SEASON.

D. A. GILL, M.R.C.V.S., D.V.S.M., Assistant Officer in Charge, Wallaceville Veterinary Laboratory.

THE investigation regarding the mortality among lambs about two to six weeks old, commonly called pulpy kidney, was continued at Ranfurly, Central Otago, during last spring. From an investigational point of view it was a disappointing season, as there was less trouble from the disease than has been the case for some years past, and consequently the number of suitable lambs for the purposes of the work was very limited. However, it is felt that some progress was made, and the very fact that the losses were fewer this season provides useful evidence of the part that nutrition plays, indirect though it may be, in the causation of the disease. Only a summary of the season's work is given here, because the details would serve no useful purpose to *Journal* readers generally at the present stage.

On the technical side the main endeavour was to establish whether or not a poisonous substance was formed in the intestines of affected lambs, which would cause the disease if it were absorbed into the body itself. When suitable, living, affected lambs were obtainable, preparations were made from the contents of the small bowel and tested for the presence of poisonous properties by making inoculations into the veins of mice. In a proportion of cases evidence of the presence of powerful poisons was found in this way, and the fluids containing them were then injected into healthy lambs that were very kindly given by local farmers for the purpose. Three out of four lambs that were inoculated died as a result within three to twelve hours, and showed symptoms and post-mortem findings that were very similar to—in fact, indistinguishable from—the naturally occurring cases.

While this requires a great deal of confirmatory work, which must be done in greater technical detail than was possible at Ranfurly, it is felt that it has served to focus attention on a definite line of investigation, with greater prospect of elucidating the problem than has been the case up to the present.

A large number of blood and urine analyses were made with a view to ruling out certain possible factors, and were successful in doing so. Facilities for Mr. S. W. Josland, of the Wallaceville staff, to carry out the biochemical work involved were kindly allowed us at the Medical School in Dunedin.

Arrangements were made for the analyses of the milks of a large number of ewes for the purpose of observing the differences in quality and quantity, if any, between the milk of normal ewes and that of ewes whose lambs had died of pulpy kidney. A further object was to find out the effect on the milk-yield of yarding ewes for twenty-four hours (as is done at five- to seven-day intervals in order to prevent losses). Mr. L. H. James, M.Sc., of the Dominion Laboratory, Dunedin, was good enough to carry out the analyses again this season.

Through the co-operation of interested farmers around Ranfurly we obtained adequate samples to establish normals, and also to test the

effect of yarding, but only three were forthcoming from ewes whose lambs had died. The reason was that not only were fewer lambs lost, but that this season the ewes as a whole had not as much milk as usual. They therefore did not stay by the dead lambs as they usually do, and so could not be identified. Nevertheless the figures obtained are significant when taken in conjunction with those obtained previously, and especially when considered in the light of the decreased losses this season, which will be referred to shortly.

The sample from each ewe was collected over a period of twenty-four hours. The ewes were stripped out at about 6 a.m. and the milk discarded. They were then milked out dry at noon, about 6 p.m., and finally again at about 6 o'clock the following morning. The quantity given at each milking was noted. Two samples from each ewe were analysed: "A" the mixed midday and evening milk, and "B," the morning milk. The following table shows the averages of the figures obtained :—

Table 1.

——	Fat.	Protein.	Ash.	Sugar.	Total Solids.	Quantity yielded in Twenty-four Hours.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Ccs.
Nine ewes, yarded, A ..	6·50	4·77	0·88	5·12	17·22	329
B ..	7·17	5·28	0·96	4·73	18·14	
Eight ewes, grazing, A ..	5·90	4·91	0·90	5·23	16·96	671
B ..	3·51	5·08	0·92	5·11	14·60	
Three ewes, lambs died, A ..	4·63	5·52	0·98	6·04	17·17	838
B ..	4·60	5·53	0·99	4·75	15·70	

The major points to comment on are, of course, that yarding for twenty-four hours reduces the milk-yield, temporarily, by about one-half, and that the ewes whose lambs died gave considerably more milk, and of slightly better quality, especially in the morning, than did normal grazing ewes.

The figures obtained this season are by no means so striking from the point of view of quality as were those obtained by Mr. Hopkirk in the previous year, when the weather and feed conditions were much more as usual. His averages were as follow :—

Table 2.

——	Fat.	Protein.	Ash.	Sugar.	Total Solids.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Lost twins (four ewes)	7·78	5·37	0·92	5·12	19·29
Lost singles (sixteen ewes) ..	5·29	5·49	0·90	4·76	16·44
Normals (fourteen ewes) ..	4·69	4·80	0·87	5·43	15·82

As already mentioned, it was apparent during the period of the investigation that there were far fewer losses on the whole than during the previous season. Since the ewes had come to lambing in much lower

condition than usual, a comparison of the two season's losses on a number of individual farms, with remarks as to the wintering of the ewes, will be of interest.

Table 3.

Farms where Ewes wintered about as well as usual.

Farm No.	Loss Percentage, 1929.	Loss Percentage, 1930.	Condition of Ewes, &c.
1 ..	2·8	10·0	Ewes brought from poor tussock in April to this good grass farm. Did exceptionally well.
2 ..	4·0	4·8	Very well wintered on good pasture. Ewes in very good order at lambing.
3 ..	7·3	6·6	Well wintered on lucerne hay and pasture.
4 ..	7·0	7·0	Very well wintered on hay and pasture. Lambed in very good condition.
5 ..	5·6	4·2	Well wintered with turnips and lucerne hay. Lambed in good condition.
6 ..	23*	40*	Ewes better wintered than any in same district; very well even for a normal year.

Farms where Ewes not wintered as well as usual.

1 ..	4·17	1·9	Wintered harder than usual. Lambing condition below normal.
2 ..	4·0	2·0	
3 ..	5·0	2·0	
4 ..	52*	17*	
5 ..	40*	12*	
6 ..	9·4	0·0	Ewes hardly wintered, and much below normal at lambing.

* Actual number of lambs lost—not percentage.

It will be realized that each season the work done and observations made have consistently shown, either from one point of view or another, that this is a disease which depends very largely on a predisposing factor, and that such factor is bound up with the condition of the lamb.

Plans for next Season.

It is intended next season to carry out more detailed work on the contents of the small gut of affected lambs, in view of the results obtained this past spring, and also to conduct some more controlled experiments on the effect of yarding in checking the losses. This method of controlling the disease has given good results wherever it has been properly applied, but many farmers are prejudiced against it because of the additional labour involved. To be carried out properly it requires the drafting of ewes into mobs as they lamb, so that the lambs in any mob are within about a week of each other in age. This is undoubtedly good farming practice wherever it can be done, and on the type of country where these losses occur it is almost always possible, except for the need of more fencing (smaller paddocks), on many farms.

Cross-fertilization of Maize.—A farmer near Gisborne is reported to have grown Leeming's (Australian) and Horsetooth maize in the same paddock, with only two rows of potatoes between, for four years. There does not appear to have been any cross-fertilization, and the seed seems to be as pure as originally.

STOCK-LICKS IN DRY SEASONS.

B. C. ASTON, Chief Chemist, Department of Agriculture.

THE aphorism "the soil is the child of the climate" has not received that general recognition in New Zealand which the truth warrants. It is more especially in the South Island that the influence of climates on the same soil-formers results in different types of farming developing in areas having different rainfalls, the soils being derived from rocks of the same composition originally. In the North Island droughty seasons occur in the Wairarapa and Hawke's Bay areas, and occasionally in Taranaki, but there is not the same constancy in climate that there is in the South Island.

A study of the local meteorology may reveal a reason for low returns from stock when other conditions of environment do not offer an explanation. It is from the soil that the pasture obtains those mineral foods so essential to both plant and animal. One of the most important constituents of the soil is water, which acts as a carrier of minerals from the soil to the plant. Pasture plants take up under favourable conditions much more mineral food than they require for healthy growth. This fact is utilized in farming to make the pasture convey more mineral food from the soil to the animal in a palatable form by top-dressing the pasture with mineral fertilizers. At the same time the pasture is made by this means more attractive and nutritious, and the production of pasture and therefore the carrying-capacity per acre is much increased.

Top-dressing mixtures do not, as at present used, intentionally include some mineral foods essential to the animal, because these do not increase production of pasture. It is customary to give such minerals to the animal direct as a stock-lick. Examples of these mineral foods benefiting the animal but not the plant are sodium and chlorine given as common salt (sodium chloride); iron—highly necessary in some sandy and perhaps peaty districts—given as citrate, carbonate, or hydrated oxide mixed with the salt; and iodine given in minute doses with the salt as potassium iodide. Special crops such as mangels, asparagus, and some others benefit by applications of salt as a manure, while potatoes and some other crops may have iron sulphate and profit by it; but pasture is not in general practice dressed with salt or iron, although both may at times be applied as impurities in the fertilizer used—salt in kainit or potash manures, and iron in basic slag.

A somewhat sharp distinction may therefore be made in considering mineral foods between those which do increase production of pasture or carrying-capacity, and those which do not but are of primary value to the animal. Thus phosphates of calcium, which are the chief fertilizers used for New Zealand soils, are highly effective in increasing production and quality of pasture; and as these phosphates are an important animal requirement it has become the fixed practice to give such phosphates through the grass to the animal, so initiating a beneficent cycle of improvement on the farm, which finds immediate response in the well-being of pasture and animal. Should, however, droughty soil conditions occur as the result of an abnormally dry season (or it may be even the normal drought of summer is responsible but

not recognized as an adverse factor) the pasture is unable to assimilate an excess of phosphate from the soil required by the animal, which suffers from mineral hunger, resulting in diminished production. If the starvation be prolonged or unusually severe in the case of phosphate-starvation, symptoms of malnutrition develop, the animal shows a craving for bones, &c., and ultimately becomes lame. It is then that remedies are first sought by the farmer, and the quickest relief is afforded by drenching the animal with some soluble phosphate, preferably (as originally demonstrated by Dr. C. J. Reakes) with syrup of phosphate of iron.

A striking instance of the close dependence of the nutritive value of pasture on rainfall was given in the last number of this *Journal*. In the Wairarapa, largely an inland district surrounded by mountains, meteorological conditions vary considerably from year to year, so that in three consecutive summers the phosphoric acid content of the pasture varied correspondingly with the changing amount of rainfall. As the nitrogen and therefore the protein content varies roughly with the phosphoric acid content, it will be seen that the nutritive value of a given weight of summer pasture is largely dependent on the rainfall. The lesson to be learnt from this truth is that a soil which in wet summers produces pasture with a fair amount of phosphoric acid may in dry summers provide insufficient to keep the production up to normal, and the nutritive value of the pasture may fall to a figure for protein one-half of that provided in a wet summer.

The remedy for mineral deficiency is simple enough, and there is a long series of experiments in drought-stricken lands to point the way. When the animal is unable to obtain sufficient phosphate from the pasture the obvious treatment is to give phosphates as a lick mixed with salt direct to the animal. There is evidence to show that of all phosphates bonedust is that from which the elements are most readily absorbed by the animal. Any excess not utilized passes through the digestive system and is voided on the pasture, so that nothing is wasted. As an insurance, therefore, against lowered production due to phosphate hunger in droughty or abnormal seasons, or phosphate deficiency in the diet due to any other cause, the use of bonedust mixed with an equal weight of salt is recommended. Bonedust supplies both lime and phosphoric acid. In the event, therefore, of calcium being deficient in the food-supply, bonedust may also supply this deficiency. If the animal gets low enough in condition, however, medicinal drenching is the appropriate remedy, as above stated.

Recent developments in bush-sick districts have shown the very great value of animal licks to supply iron deficient in the pasture direct to sheep and cattle. Iodine has been successfully used in lick form in the iodine-deficient districts of Lake Wanaka. Salt is universally recognized as a necessity for farm stock wherever the best results are desired. The extension of the salt-lick method to include phosphate is a logical development, and one which will overcome phosphate hunger caused by seasonal or abnormal droughts, which occurs in spite of top-dressing the pasture. The writer looks to the stock-lick to effect a great step forward in the pastoral development of this Dominion, and this method of improvement is all the more attractive owing to the comparatively low expense entailed.

ADDITIONS TO THE RECORDED PLANT-DISEASES OF NEW ZEALAND.

G. H. CUNNINGHAM, Mycologist, Plant Research Station, Palmerston North.

THE following diseases have been identified from material forwarded to the Mycological Laboratory during 1930. They are recorded for the information of overseas workers and in order that our records may be brought up to date.

Alternaria Citri Pierce: This fungus, the cause of a black heart-rot of oranges in California, was isolated from "Poorman" oranges grown at Henderson, near Auckland. The organism was isolated from scabbed and discoloured areas somewhat resembling those induced by the grey-scab organism.

Fusarium conglutinans var. *Callistephi* Beach: This fungus has been isolated from Chinese asters sent in from various parts of the Dominion. It has proved a serious disease of this host, causing a destructive wilt.

Fusarium Dianthi Prill. et Del.: This organism was isolated from plants sent in to the Horticulture Division by an Auckland firm of nurserymen. It is the cause of a root-rot of carnations, especially of plants grown from cuttings.

Gloeosporium musarum Cke. et Mass.: This is a frequent isolant from decaying fruits taken by Fruit Inspectors from shipments of Pacific Island bananas. In addition to producing an anthracnose condition of the skin, it frequently causes a decay of the pulp.

Macrosporium tabacinum Ell. et Ev.: This fungus was isolated from small leaf-spots on tobacco-leaves forwarded by the Tobacco Instructor from Rotorua. It was also isolated from the same line of seed from which these plants were grown, and from leaf-spots developing on plants grown on the Plant Research Station Area from this line of seed.

Phyllachora Pastinacae (West.) Rostr., the cause of a leaf-spot of parsnip, has been forwarded from the New Plymouth district.

Phlyctaena linicola Speg.: This, a seed-borne parasite of linseed, has become troublesome on certain lines of this host grown at the station area, attacking leaves and stems. It has been noted as being prevalent during the past four or five seasons in the linseed areas of Canterbury.

Phoma Persicae Sacc. has been isolated from peach laterals sent by the Orchard Instructor, Alexandra, and material collected by myself at Hastings. The fungus causes a shot-hole of the leaf, and additionally a rough-bark canker on laterals through which brown-rot readily penetrates.

Phomopsis Citri Fawcett: This fungus was isolated from lemon fruits forwarded from Tauranga by the district Orchard Instructor. Inoculation experiments demonstrated that it was responsible for the condition known as melanose in the orchards of that locality. This condition is characterized by the peculiar dark-brown spots spattering the surface of the fruit and often arranged in irregular lines.

Verticillium albo-atrum Reinke et Berth. has been isolated from potato tubers and stems from material gathered in numerous localities throughout the Dominion. It has been demonstrated to be one of the causes of wilt of potatoes. The fungus has also been isolated from diseased tomato-roots from Lower Hutt and Nelson.

SOME PRESENT ASPECTS OF THE LIMING OF GRASSLAND.*

R. P. Connell, M.A., Fields Division, Palmerston North.

Several fairly recent developments in the use of fertilizers and lime as means towards farm-improvement are worth study. In the first place, the amount of lime used in the Dominion tended to remain fairly constant, despite slight fluctuations which compensated one another over a series of years. For instance, 91,000 tons of lime were carried on the railways in 1925. This quantity rose to 102,000 tons in 1926, and dropped to 100,000 in 1927. But since 1927 this fairly stable position has changed suddenly. During the year ended 31st March, 1930, more than 3 acres of grassland were limed for every acre limed in the year ended March, 1928, a 200-per-cent. increase in acreage in two years.

The growth in the area of grassland limed has not occurred, it is pleasing to note, at the expense of the area of grass top-dressed with fertilizers. This is made clear from a comparison of the increases, during the two years just mentioned, in the areas dressed with lime and with artificial fertilizers respectively. From 1927 to 1929 the area dressed with lime increased by 240,000 acres, but during the same period the area dressed with artificial fertilizers increased by over 1,000,000 acres. Hence, though the area limed in 1929 was three times the size of that limed in 1927, while the area top-dressed had not doubled, yet the latter increase represented much the greater acreage—more than four times greater. This is because the amount of liming done at the commencement of the period under consideration was relatively small. And this is still so, since for each acre of grassland limed in 1930 more than 8 acres were dressed with artificial fertilizers.

A possible Cause of increased Liming.

The present trend seems to be towards an increased use of lime on grassland. It may well be asked, To what is the increased use of lime due, and is it to be taken as a mark of better farming? Some would have no hesitation in affirming that an increase is indicative of better farming, but there are certain aspects of the position which do not support this view.

In the first place, let us consider what may have led to the increased use of the lime. In this connection it is well to recall that the period under consideration has been one of falling prices for farm-products, during which farmers naturally search for ways of reducing their expenditure. The tone of certain inquiries received by the Fields Division

* Substance of a radio broadcast lecturette.

suggests that at least some farmers have been looking to the use of lime as a means of cutting down their outlay on fertilizers. They seek approval of plans to use lime instead of fertilizer. That lowering of expenditure is the objective which may have led to some of the increased use of lime is supported by the fact that no other adequate reason for a sudden expansion in the use of lime can be readily found. In recent years investigations have not yielded new results which could reasonably be expected to have led to a trebling of the area of limed grassland after it had previously remained fairly constant. It is true that recent trials in Canterbury suggest extending the use of lime on Canterbury pastures, but the results of these trials have not been known long enough to have affected the position under consideration. In any case the use of lime has expanded most rapidly in the North Island, where the Canterbury trials would not be accepted as a reliable guide.

Difficulties of determining Lime Response.

In New Zealand liming of grassland has produced very varying results. In some instances field results point definitely to the advisability of liming ; in other instances—which almost certainly are of more frequent occurrence—field results provide no evidence that liming is either definitely profitable to the farmer or even beneficial to the pasture. Such widely differing results are hardly surprising in view of the great diversity of soils and climates which are embraced in our farming. But the practical farmer may ask, How am I to know when to lime and when not to lime ?

The task of answering this question is made specially difficult by the fact that although there may be no visible evidence it does not follow that the lime is having no influence. This is because in certain cases influence of lime may be reflected in altered feeding-value but not in altered appearance of the herbage. Invisible changes may take place in the pasture growth because of liming, and these changes may so beneficially affect stock as to make the liming worth while.

From all this it follows that the influence of lime on grassland is not easily measured. The following statement by Professor Stapledon, of Aberystwyth, Wales, indicates the general position : " It is only occasionally and in very bad cases that liming actually adds to the bulk or weight of grass per acre, but it very frequently has a considerable influence on quality." Research work in New Zealand has tended to confirm this statement. For example, Rigg and Askew report that liming on a Nelson pasture has not resulted in any increase in the hay yield, whereas it has had an important effect in increasing the percentage of other constituents in the pasture, particularly potash and nitrogen, although it has not increased the percentage of lime.

It is questionable whether similar work would yield similar results in other districts, and the cash value of the extra nitrogen and potash may not be great, but the Nelson results are worth giving in illustration of the fact that it is not altogether easy to determine when liming would prove profitable and when not. If quality of herbage is as important in assessing the influence of lime as some assert, then trials based on weight of growth or appearance of growth cannot be expected to provide definite conclusions.

Because of the obvious need for some ready reliable means of ascertaining when liming is advisable, various attempts have been made to evolve satisfactory methods of testing soils. A number of these methods are in use commercially. Some of them depend on colour changes and can be carried out in the open field. Others are not so simple and call for the use of a laboratory. Some are known as "lime-requirement" tests; some as "soil-acidity" tests. Some of these tests have been tried in New Zealand, and proved unreliable as guides to economic farming. In connection with such tests in general, Sir John Russell, Director of the Imperial Bureau of Soil Science, says, "Before any indication can be given of the amount of lime required, it is necessary to make field trials." From this it is clear that not much reliable guidance can be expected from quick and easy tests to determine what amount of lime should be applied to a soil.

Guidance provided by Field Experience.

Fortunately, extensive and careful observations have provided some guidance in regard to the economic use of lime. In the first place, in New Zealand as a general rule the soil is naturally weakest as a source of crop-nourishment in its phosphate content. It follows that the first step ordinarily should be the application of phosphates such as superphosphate and basic slag. If top-dressing with phosphates is persevered with a stage will be reached when phosphate content is no longer the weakest link in the chain of factors giving soil-fertility. It then becomes advisable to strengthen what is the weakest link, which conceivably may be the lime content. Then the stage has arrived that calls for the use of lime. On the other hand, it is possible that lime may prove to be the weakest link from the start. If this is the case the soil will not respond well to initial dressings of phosphates. When the response to phosphates is poor liming is always worth a trial, unless there is some other obvious weak link in the chain of factors giving fertility.

It follows also from what has just been indicated that land which has been dressed with phosphates for some years is more likely to respond profitably to liming than land which has not been treated previously with artificial fertilizers. At times attractive returns from liming may be obtained, even though the phosphated land is still giving fairly good returns from phosphates alone. As a working rule land which does not respond well to phosphates should be placed under suspicion of being in need of lime. In the second place, lime alone seldom proves a worth-while proposition, whereas lime applied in conjunction with phosphates may constitute excellent practice.

It is not to be inferred from statements already made that liming is not beneficial. In certain circumstances liming may be not only beneficial but also profitable, and yet not be the best practice under certain economic conditions. This is a position which is particularly likely to arise in the present financial stringency. When the amount of money that may be expended on soil dressings is limited, the question to be considered is not whether the use of lime is profitable, but whether it is more profitable than the use of some other material such as phosphates. For the Dominion as a whole the available phosphate supply is the weakest link in the chain of factors giving fertility. This fact provides general guidance.

Amount of Lime applied per Acre.

An interesting position exists in regard to the amount of lime applied per acre of the area of limed grassland in the Dominion. The average amount applied in 1929–30 was $5\frac{1}{5}$ cwt., this being 40 per cent. less than the average amount applied per acre in 1927–28. Consideration of the average in this instance, however, does not give an accurate indication of what is taking place in the whole of New Zealand. This is because much the greater part of the increased acreage limed is in Auckland Province, which is characterized also by using a relatively small amount per acre—an amount that seems still to be falling. It was just over 3 cwt. per acre of the limed grassland in 1929–30. Hence the influence on the average figures for the Dominion, of the rapid expansion of the Auckland limed acreage, which receives a light dressing, is apt to give an inaccurate impression of Dominion tendencies unless, as has just been done, one goes beyond merely the average figures.

Actually, in some of the districts where lime is freely used, the amount applied per acre tends to remain steady and considerably above that of Auckland. In Otago, for instance, on grassland which was limed the average dressing for the past two seasons has been 10 cwt. per acre, and in Southland $7\frac{1}{2}$ cwt., while in the Wellington District the average dressing on limed grassland has risen from 6 cwt. to 7 cwt. in the two seasons.

Really we have contradictory tendencies and diverse practices in different districts. At first sight it seems that one at least of these must be wrong. Actually both may be right. This is because lime may be applied in order to obtain one or more different effects; it may be used to prevent sourness, or it may be used to improve the physical condition by flocculating clay. By its flocculating effect on clay, liming may make a heavy soil more open in texture. Where only a small amount of clay is present the flocculating action is less needed, or possibly not needed at all, and a smaller amount of lime suffices. From this it follows that clay soils may respond profitably to several times as much lime as would sandy soils. In one district improvement of the physical condition of the soil may be the objective, in another locality prevention of sourness. In the former district a tendency to heavier dressings may be sound while in the latter a tendency to lighter dressings may be equally sound. Further, one would naturally expect the price of lime to be a factor in determining the weight of dressings of lime, and hence the heavier dressings adopted in Otago and Southland are probably linked up to some extent with the lower cost of lime in those districts.

It is not possible to deal here satisfactorily with the quantity of lime per acre that should be used. The question involves considerations that may more suitably be discussed with the officers of the Fields Division in charge of different districts. The general tendency, however, may be mentioned. It has been towards a lowering in the quantity of lime applied per acre. Heavy dressings at relatively long intervals, which were common in the past in certain districts, are now criticized by some because it is alleged they involve the locking up of finance which is non-productive for a period—a result which could be avoided. Heavy dressings are also criticized because it is believed there would be more loss of lime by leaching from one heavy dressing than from

the same amount of lime applied in several small dressings at intervals over the same period as the heavy dressing is expected to function. Doubt may well be raised, however, whether these considerations against heavy dressings always apply, and whether at times other points in favour of heavy dressings do not outweigh them.

Fineness of Grinding.

Fineness of grinding of limestones is a matter to which much thought has been given, and conclusions of practical interest have been reached from the results of New Zealand investigations. It has been found that the solubility of hard limestone is decidedly less than that of soft limestone when comparatively coarse grades are compared. It has been found, further, that this difference in solubility between hard and soft limestones tends to disappear when they are finely ground. Hence a hard limestone if ground finely enough should be as effective in the soil as a soft one, other circumstances being similar.

It is well to remember, also, that in practice fineness of grinding is not an unmixed blessing. It naturally costs more to secure an extra degree of fineness, and it always is necessary to consider whether this extra cost is justified. Again, the more finely ground the greater is the rapidity with which lime disappears from the soil. Because of this many authorities recommend a limestone consisting of varied degrees of fineness.

Summary.

Despite the general necessity to keep down farm outlay it is as a rule unwise to resort to lime as a substitute for those artificial fertilizers the worth of which has already been proved. Lime at times leads to better results from the use of the fertilizers mentioned than would have been obtained had these manures been used alone. In such cases liming is advisable. Liming by itself is seldom financially attractive. In general, the so-called lime-requirement and soil-acidity tests cannot be depended upon for direct reliable guidance as to the economic use of lime. The only reliable guidance is that provided by proper field trials. It is, as a rule, better to apply several small dressings of lime at intervals over a period rather than only one heavy dressing for the period. Before using lime extensively it is advisable to discuss the position with the district officer of the Fields Division.

Strawberry-clover for Swampy Margins.—The Fields Superintendent at Palmerston North reports that from a small quantity of strawberry-clover seed surface-sown a few years ago round the swampy margin of a small lake on the property of Mr. R. Wilson, Himitangi, an excellent sward has developed under circumstances quite unsuitable for other useful plant-life. Artificial drainage controls the level of the lake for the greater part of the year, but at certain periods during winter and spring a fairly large area round the margin is inundated for a few weeks at a time. Under these conditions the strawberry-clover appears to be spreading and thriving, and after the water has receded provides an abundant growth. Up to the present no fertilizer has been used.

WHEAT-MANURING EXPERIMENTS IN THE SOUTH ISLAND, SEASON 1930–31.

Fields Division, Department of Agriculture.

THIRTY-ONE experiments on the manuring of wheat were laid down in 1930 in Marlborough, Canterbury, and North Otago. Twenty-seven of these experiments are reported on in this article, and three others concerned with the investigation of different times of application of different forms of nitrogen will be the subject of a subsequent report in this *Journal*. One experiment had to be abandoned on account of lodging of the crop.

The method of conducting the experiments has been described in the *Journal* for July, 1926, page 6.

Types of Experiment, 1930–31.—Four types of experiments were carried out. Types A and B (see below) were a continuation of the 1929–30 programme. Type C was instituted for the reasons stated below. The fourth type of experiment will be reported on subsequently as already indicated.

The treatments used in experiments of Types A, B, and C were as follow, all amounts stated being per acre :—

Type A
(1) No manure.
(2) Superphosphate (44–46 per cent. tricalcic phosphate) .. 1 cwt.
(3) Super 1 cwt., plus muriate of potash 1 cwt. .. .. 2 cwt.
(4) Super 1 cwt., plus nitrate of soda 1 cwt. .. .. .. 2 cwt.
(5) Super 1 cwt., plus muriate of potash 1 cwt., plus nitrate of soda 1 cwt. .. .. 3 cwt.

Three experiments of this type were carried out in North Otago, where experiments have not been in progress for so long a period as in Canterbury, and the utility of potash for wheat was undecided.

Type B—
(1) No manure.
(2) Superphosphate .. .. 1 cwt.
(3) Super .. .. 2 cwt.
(4) Super 1 cwt., plus nitrate of soda 1 cwt. .. .. .. 2 cwt.
(5) Super 2 cwt., plus nitrate of soda 1 cwt. .. .. .. 3 cwt.
(6) Super 1 cwt., plus carbonate of lime 2 cwt. .. .. 3 cwt.

Sixteen experiments of this type were carried out. The nitrate of soda was top-dressed in the spring.

Type C—
(1) No manure.
(2) Super .. .. 1 cwt.
(3) Super 1 cwt., plus nitrate of soda 1 cwt. .. .. .. 2 cwt.
(4) Super 1 cwt., plus sulphate of ammonia 1 cwt. .. .. 2 cwt.
(5) Super 1 cwt., plus sulphate of ammonia 1½ cwt. .. .. 2½ cwt.
(6) Super 1 cwt., plus Leunaphos 1 cwt. .. .. .. 2 cwt.

Eight experiments of this type were carried out. The sulphate of ammonia was applied by hand about three to four weeks earlier than the nitrate of soda and Leunaphos.

Type C experiments were instituted for the following reasons:—

(*a*) Since sulphate of ammonia was cheaper, both per unit of nitrogen and per hundredweight, it was desired to get first-hand information as to how its effect compared with that of nitrate of soda when sown at the same rate per acre.

(*b*) A small amount of experimental evidence and a considerable amount of observational evidence indicated that the quantity of nitrogen per acre could be profitably increased. Hence the trial of 1½ cwt. of sulphate of ammonia per acre.

(*c*) Leunaphos is an ammonium phosphate containing 20 per cent. nitrogen and 20 per cent. phosphoric anhydride. Thus 1 cwt. of Leunaphos supplied practically the same nitrogen and phosphate as 1 cwt. of sulphate of ammonia plus 1 cwt. of superphosphate. The point under trial here was whether extra phosphate applied at the same time as the nitrogen would be beneficial, it being assumed that the nitrogen supplied in Leunaphos would be practically as effective as that supplied in 1 cwt. of sulphate of ammonia or 1 cwt. of nitrate of soda. Experiments on pasture indicated that this assumption was justified.

Size of Plot and Number of Replications.—As in the previous year each plot was 2 chains in length and 7 coulter rows wide. Twelve replications of each treatment were sown in each experiment.

Interpretation of Results.—Statistical examination of results was carried out by "Student's" method. When a difference between treatment is said to be "significant" such difference may be accepted with confidence. Where differences are "not significant" they may be real enough and due to treatments applied, but cannot be regarded as such with any degree of confidence.

Estimation of Profits or Losses from Manures applied.—No attempt has been made to assess the profits or losses resulting in the individual trials. General averages are used for estimation of monetary returns in tables. The following prices are used for computing these returns, and in the case of manures are the approximate prices plus maximum railage: Wheat, 4s. 3d. per bushel (per bushel cost such as threshing, hauling, railage, &c., are taken as about 1s., and this amount is deducted from the average value for Tuscan on farms); superphosphate, 5s. 6d. per cwt.; nitrate of soda, 16s. per cwt.; sulphate of ammonia, 12s. 6d. per cwt.; muriate of potash, 14s. 6d. per cwt.; Leunaphos is not marketed to any extent, and the price is not known.

The amount of wheat required to meet the cost of 1 cwt. of each of the fertilizers used is approximately as follows: 1·3 bushels for 1 cwt. super, 3·8 bushels for 1 cwt. nitrate of soda, 3·0 bushels for 1 cwt. sulphate of ammonia, 3·4 bushels for 1 cwt. muriate of potash.

Particulars of Trials and Yields from Treatments.

Particulars of the individual trials and yields from the various treatments detailed are set out in Tables 1 to 4 which follow.

Table 1.—Locations of Trials, previous History of Field, Variety of Wheat, Rate of Seeding, Date of Sowing of Crop, Date of Nitrogen Application, and Date of Harvesting.

Serial No.	Experiment No.	Name.	Address.	Previous History of Field.	Variety of Wheat.	Rate of Seeding per Acre.	Date Sown.	Date Nitrogen applied.	Date Harvested.
				Type A Experiments.		lb.			
1	16/4/224	J. Stevenson ..	Weston, North Otago ..	1928–29, wheat; 1929–30, Western Wolths	Dreadnought ..	93	10/5/30	3/9/30	7/2/31
2	16/4/157	D. M. Borrie ..	Papakaio, North Otago ..	Swamp ploughed, 1928; 1929, Western Wolths	College Hunter's ..	110	23/5/30	5/9/30	19/2/31
3	16/4/155	J. D. Grant ..	Awamoa, North Otago ..	1927–28, clover; 1928–29, linseed; 1929–30, wheat	College Hunter's ..	105	14/5/30	10/9/30	6/3/31
				Type B Experiments.					
4	16/3/337	Smith Bros. ..	Tuamarina, Marlborough ..	1927–28, red clover sown with wheat; 1928–29, red clover; 1929–30, wheat	Major	118·1	13/6/30	15/10/30	12/1/31
5	16/3/431	M. Walsh	Renwicktown, Marlborough ..	Up to 1929, grass for twelve years; 1929–30, peas	Major	117	17/6/30	14/10/30	7/1/31
6	16/3/451	D. Black	Hillersden, Marlborough ..	1927–28, turnips; 1928–29, oats; 1929–30, oats	Solid-straw Tuscan	102	23/7/30	14/10/30	21/1/31
7	16/3/425	G. M. Ballantyne ..	Mina, Canterbury	1928–29, grass; 1929–30, rape	Solid-straw Tuscan	107	15/5/30	3/10/30	28/1/31
8	16/3/340	H. D. Burt ..	Hawarden, Canterbury ..	Grass three years	Solid-straw Tuscan	102	6/6/30	5/10/30	26/1/31
9	16/3/430	Rangiora High School	Rangiora, Canterbury ..	1927–28, potatoes; 1928–29, peas; 1929–30, wheat	Solid-straw Tuscan	110	20/6/30	3/10/30	5/2/31
10	16/3/298	H. E. Evans ..	Fernside, Canterbury ..	1928–29, grass; 1929–30, rape	Solid-straw Tuscan	105	29/5/30	3/10/30	28/1/31
11	16/3/302	T. E. Pearson ..	Hororata, Canterbury ..	Grass for several years ..	Solid-straw Tuscan	96	10/5/30	19/9/30	26/1/31
12	16/3/423	W. E. Brooker ..	Lyndhurst, Canterbury ..	Prior to 1929–30 in grass; 1929–30, wheat	Solid-straw Tuscan	86	19/6/30	23/9/30	10/2/31
13	16/3/421	J. O'Grady ..	Winchmore, Canterbury ..	Grass for five years ..	Solid-straw Tuscan	106	30/5/30	17/9/30	10/2/31

Table 1 continued.

Serial No.	Experiment No.	Name.	Address.	Previous History of Field.	Variety of Wheat.	Rate of Seeding per Acre.	Date Sown.	Date Nitrogen applied.	Date Harvested.
				Type B Experiments—continued.					
						lb.			
14	16/3/420	J. Finlay	Eiffelton, Canterbury ..	Prior to 1927 in grass; 1927–28, wheat; 1928–29, wheat; 1929–30, mangels	Solid-straw Tuscan	106	24/6/30	26/9/30	28/2/31
15	16/3/417	W. J. Bell	Southburn, South Canterbury	Grass for four years ..	Solid-straw Tuscan	90	2/6/30	17/9/30	7/2/31
16	16/3/414	A. W. Barnett ..	Morven, South Canterbury ..	Grass for four years ..	College Hunter's ..	72	23/5/30	18/9/30	17/2/31
17	16/4/223	D. Manson	Enfield, North Otago ..	Grass, 1927–30	College Hunter's	121	12 and 13/5/30	11/9/30	18/2/31
18	16/4/225	T. Perry	Teschmakers, North Otago ..	Grass for twelve years, ploughed, and fallowed	Dreadnought ..	108	18/5/30	5/9/30	6/2/31
19	16/4/154	J. Newlands ..	Ngapara, North Otago ..	Grass for several years; 1928–29 and 1929–30, oats	College Hunter's ..	105	20/5/30	19/9/30	20/2/31
				Type C Experiments.					
20	16/3/301	G. H. Cross ..	Oxford, Canterbury ..	Grass	Solid-straw Tuscan	108	24/5/30	3/9/30* 3/10/30	29/1/31
21	16/3/424	F. W. Gartery ..	Cust, Canterbury	1928–29 grass; 1929–30 wheat	Solid-straw Tuscan	98	20/5/30	2/9/30 3/10/30	22/1/31
22	16/3/6	D. Mulholland ..	Darfield, Canterbury ..	Grass	Solid-straw Tuscan	112	17/6/30	25/9/30 13/10/30	31/1/31
23	16/3/422	J. Ruddenclau ..	Methven, Canterbury ..	1928–29, grass; 1929–30, oats	Solid-straw Tuscan	107	5/6/30	30/8/30 18/9/30	10/2/31
24	16/3/156	A. Amos	Wakanui, Canterbury ..	Grass; wheat followed by peas, 1929–30	Solid-straw Tuscan	105·6	29/5/30	26/8/30 16/9/30	9/2/31
25	16/3/418	W. Ford	Geraldine, South Canterbury	Grass for three years ..	Solid-straw Tuscan	120	6/6/30	26/8/30 16/9/30	18/2/31
26	16/3/419	D. France	St. Andrews, South Canterbury	1928, wheat out of grass; 1929, potatoes	Velvet	120	14/6/30	27/8/30 17/9/30	6/2/31
27	16/3/416	T. S. Medlicott ..	Waimate, South Canterbury	Grass for four years ..	College Hunter's ..	90	30/5/30	27/8/30 18/9/30	16/2/31

*The first date indicates the date of application of sulphate of ammonia; the second date is that when nitrate of soda and Leunaphos were applied.

Table 2.—Yields in Bushels per Acre from different Treatments in Type A Experiments.

Serial No.	No Manure.	Super 1 cwt.	Super 1 cwt. + Potash 1 cwt.	Super 1 cwt. + Nitrate of Soda 1 cwt.	Super 1 cwt. + Potash 1 cwt. + Nitrate of Soda 1 cwt.
1	75·0	76·3	72·8	76·9	79·0
2	77·3	78·8	75·1	78·7	78·0
3	53·6	56·7	53·2	60·8	57·7

Table 3.—Yields in Bushels per Acre from Different Treatments in Type B Experiments.

Serial No.	No Manure.	Super 1 cwt.	Super 2 cwt.	Super 1 cwt. + Nitrate of Soda 1 cwt.	Super 2 cwt. + Nitrate of Soda 1 cwt.	Super 1 cwt. + Lime 2 cwt.
4 ..	27·0	*	40·9	39·7	44·9	41·4
5 ..	28·2	29·5	32·5	32·0	34·0	33·5
6 ..	15·3	16·5	17·2	19·9	21·3	18·1
7 ..	39·9	45·5	47·0	47·9	48·7	48·0
8 ..	30·5	34·5	33·8	36·4	36·6	34·6
9 ..	70·7	76·2†	76·3	77·9†	80·2	76·4
10 ..	21·8	23·5	23·5	27·1	28·0	22·4
11 ..	24·2	31·3	32·8	37·7	37·3	33·3
12 ..	35·0	40·3	41·0	41·7	43·3	41·0
13 ..	24·2	26·0	26·0	26·2	26·3	26·2
14 ..	24·6	27·7	28·6	32·5	34·4	28·0
15 ..	44·9	50·4	52·9	50·3	53·3	52·6
16 ..	79·9	84·6	83·1	85·9	84·0	84·4
17 ..	60·1	62·6	61·7	66·0	63·4	62·1
18 ..	66·4	67·2	67·6	68·4	67·1	65·0
19 ..	51·6	52·0	51·3	56·2	56·8	53·5

* The yield of super 1 cwt. in No. 4 experiment is not recorded, as, owing to a mishap with the drill at time of sowing, the result is not reliable.

† Throughout the sowing of the super 1 cwt. and super 1 cwt. plus nitrate of soda 1 cwt. plots a drill coulter was blocked. From the fact that super 1 cwt. has yielded practically as well as super 2 cwt. it would appear that there is no difference of moment between these treatments, and that the rows on each side of the missed one have been able to take full advantage of the strip not sown.

Table 4.—Yields in Bushels per Acre from Different Treatments in Type C Experiments.

Serial No.	No Manure.	Super 1 cwt.	Super 1 cwt. + Nitrate of Soda 1 cwt.	Super 1 cwt. + Sulphate of Ammonia 1 cwt.	Super 1 cwt. + Sulphate of Ammonia 1½ cwt.	Super 1 cwt. + Leunaphos.
20 ..	24·1	28·6	27·5	27·0	28·6	27·7
21 ..	21·3	24·2	28·0	28·6	32·1	27·1
22 ..	28·2	29·5	32·5	32·0	34·0	33·4
23 ..	31·6	35·1	39·4	38·3	40·2	36·8
24 ..	47·8	50·0	50·3	52·8	54·6	52·6
25 ..	33·9	34·8	40·4	39·6	42·4	38·8
26 ..	31·0	32·8	35·2	34·9	35·8	33·7
27 ..	42·4	50·0	54·2	54·3	56·3	55·0

Analysis of Effects of Manures.

The increases due to treatments are shown in Tables 5 to 8, supplemented by detailed comments.

Table 5.—Differences in Yields in Bushels per Acre between (a) *Super 1 cwt. and No Manure;* (b) *Super 1 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt.;* (c) *Super 1 cwt. plus Nitrate of Soda 1 cwt. and No Manure. (Type A, B, and C Experiments.)*

Serial No.	Increase due to Manures.			Serial No.	Increase due to Manures.		
	Increase of Super 1 cwt. over No Manure.	Increase of Super 1 cwt. + Nitrate of Soda over Super 1 cwt.	Increase of Super 1 cwt. + Nitrate of Soda 1 cwt. over No Manure.		Increase of Super 1 cwt. over No Manure.	Increase of Super 1 cwt. + Nitrate of Soda over Super 1 cwt.	Increase of Super 1 cwt. + Nitrate of Soda 1 cwt. over No Manure.
1	1·3	0·6	1·9	15	**5·5**	—0·1	**5·4**
2	1·5	—0·1	1·4	16	**4·7**	1·3	**6·0**
3	3·1	**4·1**	**7·2**	17	**2·5**	3·4	**5·9**
4	..	..	**12·7**	18	0·8	1·2	2·0
5	**3·4**	**5·1**	**8·5**	19	0·4	**4·2**	**4·6**
6	**1·2**	**3·4**	**4·6**	20	**4·5**	—0·9	**3·6**
7	**5·6**	**2·4**	**8·0**	21	**2·9**	**3·8**	**6·7**
8	**4·0**	**1·9**	**5·9**	22	**1·3**	**3·0**	**4·3**
9	**5·5**	1·7	**7·2**	23	**3·5**	**4·3**	**7·8**
10	**1·7**	**3·6**	**5·3**	24	**2·2**	0·3	**2·5**
11	**7·1**	**6·4**	**13·5**	25	0·9	**5·6**	**6·5**
12	**5·3**	**1·4**	**6·7**	26	**1·8**	**2·4**	**4·2**
13	**1·8**	0·2	**2·0**	27	**7·6**	**4·2**	**11·8**
14	**3·1**	**4·8**	**7·9**				

Note.—Increases or decreases printed in heavy type are statistically significant. A minus sign preceding a figure indicates a decrease. This applies to all tables.

Comments on Table 5.

Super 1 cwt.—The average increase due to super 1 cwt. (twenty-six experiments) equals 3·2 bushels per acre. The average profit due to super 1 cwt. equals 8s. 1d. per acre.

Super has increased the yield to a significant extent in twenty out of twenty-six experiments. In the cases of the six experiments showing non-significant differences due to super it should be noted that the differences between super and no manure are consistently in favour of super, and although not statistically significant are probably real differences.

Nitrate of Soda.—The average increase due to nitrate of soda 1 cwt. (twenty-six experiments) equals 2·6 bushels per acre. This is the lowest average increase for any season since the trial of nitrate of soda was inaugurated. The extremely dry pre-harvest period reacted unfavourably towards nitrogen, and some experiments showing excellent promise of a good nitrogen response about November failed to show an appreciable increase in yield.

Nitrate of soda has given significant increases in sixteen out of twenty-six experiments, but on the basis of 3·8 bushels of wheat being required to pay for 1 cwt. of nitrate of soda only eight experiments show a paying return. The average loss due to the use of nitrate of soda amounts to 5s. per acre.

The average increase due to super 1 cwt. plus nitrate of soda 1 cwt. (twenty-seven experiments) equals 6·1 bushels per acre. This is just over 2 bushels per acre less than in the previous season. The average profit per acre due to super plus nitrate of soda equals 4s. 6d per acre. On the average the use of nitrate of soda has not been paying in the season under review.

Table 6.—Differences in Bushels per Acre (a) *when Super plus Potash is compared with Super;* (b) *when Super plus Potash plus Nitrate of Soda is compared with Super plus Nitrate of Soda;* (c) *when Super plus Potash plus Nitrate of Soda is compared with Super plus Potash. (Type A Experiments.)*

Serial No.	Super + Potash.	Super + Potash + Nitrate of Soda.	
	Increase or Decrease in Relation to Super 1 cwt.	Increase or Decrease in Relation to Super + Nitrate of Soda.	Increase or Decrease in Relation to Super + Potash.
1	−3·5	2·1	**6·2**
2	**−3·7**	−0·7	2·9
3	**−3·5**	**−3·1**	**4·5**

Comments on Table 6.

Potash.—The average decrease due to potash when used with super equals 3·5 bushels per acre. The average decrease due to potash when used with super plus nitrate of soda equals 0·6 bushels per acre. Potash added to super depressed the yield significantly in Experiments 2 and 3. The financial aspect of the use of potash does not need comment.

Nitrate of Soda.—The average increase due to nitrate of soda when used with super and potash equals 4·5 bushels per acre.

Table 7.—Differences in Yields in Bushels per Acre between (a) *Super 2 cwt. and Super 1 cwt.;* (b) *Super 2 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. plus Nitrate of Soda 1 cwt.;* (c) *Super 1 cwt. plus Lime 2 cwt. and Super 1 cwt. (Type B Experiments.)*

Serial No.	Super 2 cwt.—Increase or Decrease in Relation to Super 1 cwt.	Super 2 cwt. + Nitrate of Soda 1 cwt.—Increase or Decrease in Relation to Super 1 cwt. + Nitrate of Soda 1 cwt.	Super 1 cwt. + Lime 2 cwt.—Increase or Decrease in Relation to Super 1 cwt.
4	..	**5·2**	..
5	**2·8**	**2·2**	0·7
6	**0·7**	**1·4**	**1·6**
7	1·5	0·8	2·5
8	−0·7	0·2	0·1
9	0·1	2·3	0·2
10	0·0	0·9	−1·1
11	1·5	−0·4	2·0
12	0·7	**1·6**	0·7
13	0·0	0·1	0·2
14	0·9	1·9	0·3
15	2·5	**3·0**	**2·2**
16	−1·5	−1·9	−0·2
17	−0·9	−2·6	−0·5
18	0·4	−1·3	−2·2
19	−0·7	0·4	1·5

Comments on Table 7.

Comparisons between Super 2 cwt. and Super 1 cwt.—The average increase of super 2 cwt. over super 1 cwt. equals 0·5 bushels per acre. Super 2 cwt. was better than super 1 cwt. to a significant extent in two experiments (Nos. 5 and 6) out of fifteen. With the exception of isolated cases there does not appear to be any advantage in increasing the quantity of super above 1 cwt. per acre. On the average of these trials the use of super at 2 cwt. per acre has resulted in a smaller profit than that from super 1 cwt. to the extent of 3s. 4d. per acre.

Comparisons between Super 2 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. plus Nitrate of Soda 1 cwt.—The average increase of super 2 cwt. plus nitrate of soda 1 cwt. over super 1 cwt. plus nitrate of soda 1 cwt. equals 0·9 bushels per acre. In five experiments out of sixteen the treatment containing the greater quantity of super gives significant increases.

There is a tendency for greater quantity of super to be more effective when nitrogen is added, but on the average the use of the greater quantity of super does not appear justified.

Comparison between Super 1 cwt. plus Lime 2 cwt. and Super 1 cwt.—The average increase of super 1 cwt. plus lime 2 cwt. over super 1 cwt. equals 0·6 bushels per acre. In Experiments 6 and 15 the addition of lime has caused significant increases. Experiments 7 and 11 also show fair increases due to lime, though not to a significant extent. The soils in the districts where these experiments were situated respond markedly to lime, although some of the other experiments are on lime-response soils and do not show any appreciable effect from the use of 2 cwt. of lime.

Table 8.—Differences in Yields in Bushels per Acre between (a) *Super 1 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. plus Sulphate of Ammonia 1 cwt.*; (b) *Super 1 cwt. plus Sulphate of Ammonia 1 cwt. and Super 1 cwt. plus Sulphate of Ammonia 1½ cwt.*; (c) *Super 1 cwt. plus Sulphate of Ammonia 1 cwt. and Super 1 cwt. plus Leunaphos 1 cwt.*

Serial No.	Super 1 cwt. + Nitrate of Soda 1 cwt.—Increase or Decrease in Relation to Super 1 cwt. + Sulphate of Ammonia 1 cwt.	Super 1 cwt. + Sulphate of Ammonia, 1½ cwt.—Increase or Decrease in Relation to Super 1 cwt. + Sulphate of Ammonia 1 cwt.	Super 1 cwt. + Sulphate of Ammonia 1 cwt. — Increase or Decrease in Relation to Super 1 cwt. + Leunaphos 1 cwt.
20	0·5	1·6	—0·7
21	—0·6	**3·5**	**1·5**
22	0·5	**2·0**	0·6
23	**0·9**	**1·9**	**1·5**
24	—2·5	**1·8**	2·0
25	0·8	**2·8**	0·8
26	0·3	0·9	0·8
27	—0·1	2·0	—0·7

Comments on Table 8.

Comparisons between Super plus Nitrate of Soda 1 cwt. and Super plus Sulphate of Ammonia 1 cwt.—In Experiment 23 nitrate of soda

1 cwt. is significantly better than sulphate of ammonia 1 cwt. No significant differences are shown in the remainder of the experiments.

There is practically no difference between nitrate of soda and sulphate of ammonia on the average. In the comments on Table 5 the average loss due to the use of nitrate of soda was stated as 5s. per acre. On the assumption that the effect of 1 cwt. of sulphate of ammonia is not different from that of 1 cwt. of nitrate of soda, the financial loss from sulphate of ammonia would amount to 1s. 6d. per acre, as the sulphate of ammonia costs 12s. 6d. per cwt. as against 16s. for the nitrate of soda.

Comparisons between Super 1 cwt. plus Sulphate of Ammonia 1 cwt. and Super 1 cwt. plus Sulphate of Ammonia 1½ cwt.—The higher quantity of sulphate of ammonia shows a significant superiority in five out of eight experiments. The average increase due to the extra ½ cwt. of sulphate of ammonia equals 2·1 bushels per acre, valued at 9s., and obtained at a cost of 6s. 3d.

The comparatively small number of experiments renders it inadvisable to draw definite conclusions regarding the financial aspect of the use of the greater quantity of nitrogenous fertilizer. The results have confirmed a previous experiment in which quantities of sulphate of ammonia greater than 1 cwt. were used, and also confirm observations on this point.

Comparisons between Super 1 cwt. plus Sulphate of Ammonia 1 cwt. and Super 1 cwt. plus Leunaphos 1 cwt.—Super 1 cwt. plus sulphate of ammonia 1 cwt. was significantly better than super 1 cwt. plus Leunaphos 1 cwt. in two experiments, and the superiority of the former was on the average of eight experiments 0·7 bushels per acre.

These results indicate that extra phosphate applied as a spring top-dressing does not have an appreciable effect on yield, and that the nitrogen in Leunaphos is less efficient than that of sulphate of ammonia, at least under the conditions of these trials. The Leunaphos was applied at the same time as nitrate of soda and later than sulphate of ammonia. Better results may have been obtained had the Leunaphos been applied earlier.

General Remarks on the Results.

The average increases resulting from the use of superphosphate and nitrate of soda are the lowest recorded in the last three seasons, during which time experiments have been distributed fairly widely. Apparently the extremely dry pre-harvest conditions have been responsible for the lessened response to manures. Superphosphate, however, has shown satisfactory and paying results in the main, and there is no evidence to warrant any alteration in the recommendation made previously—namely, "Apply 1 cwt. of superphosphate with wheat at seeding."

The good average results of previous seasons from nitrogen have not been repeated in the past season, but weather conditions were so abnormal as to justify the conclusion that they were chiefly responsible for the comparatively poor average effect from nitrogen. At the present price of wheat previous recommendations regarding

the use of nitrogen hold good, as it is confidently expected that under less exceptional climatic conditions its use will pay.

The use of potash in North Otago is obviously not advantageous.

The valuable co-operation of those farmers who provided land for carrying out the trials is gratefully acknowledged.

The field work was carried out by officers of the Fields Division as follows: In the Marlborough and Canterbury districts, Instructors A. G. Elliott, Blenheim, W. Stafford, Christchurch (assisted by G. G. Calder), E. M. Bates, Ashburton, and K. M. Montgomery, Timaru, under Mr. R. McGillivray, Fields Superintendent. In North Otago a big programme of work was undertaken by Mr. T. A. Sellwood, under Mr. R. B. Tennent, Fields Superintendent, Dunedin.

—A. W. Hudson, Crop Experimentalist, Plant Research Station.
—J. W. Woodcock, Assistant Crop Experimentalist.

THE CURING OF LEMONS.

PRACTICE FOR NEW ZEALAND CONDITIONS.

P. Everett, Orchard Instructor, Gisborne.

Curing is a term used to indicate certain treatment to which lemons are submitted with a view to improving the keeping-quality of the fruit. This treatment is a slow form of dehydration, and when correctly carried out greatly reduces the thickness of the rind without causing excessive wilting. Many different methods of curing have been practised in this and other countries with varying degrees of success; the practice here described, however, is considered to be worthy of recommendation to lemon-growers in New Zealand.

Grading Prior to Curing.

Lemons grown for commercial use are almost invariably picked when they attain the diameter of 2¼ in. to 2½ in., regardless of colour, unless the typical lemon colour is assumed before that size is attained. It therefore follows that at the time of picking some of the fruits will still be dark green in colour, others commencing to turn yellow, and the remainder will be quite yellow. These three stages of maturity are termed "green," "silver," and "tree-ripe" respectively.

According to the stage of maturity at picking so different treatment is required; therefore, as soon as the fruit reaches the packing-shed it should be graded according to colour. As a large lemon takes much longer to cure than a small one each of the colour-grades should be divided according to the size of the fruit; two size-grades are considered sufficient to meet the purpose. This grading of the freshly picked fruit should be done by hand, and the utmost care taken to see that the fruit is not bruised or injured in any other way, as the slightest damage to the rind at this stage is liable to cause decay during the curing process. Where small quantities are being handled the silver grade is sometimes incorporated with the other two grades.

Bath Solutions.

The curing process would be extremely simple but for certain fruit-rotting fungus diseases which are liable to cause serious losses, particularly from September to January. Probably the most troublesome of these diseases is blue mould (*Penicillium italicum* or *P. digitatum*). Rhizopus-rot (*Rhizopus nigricans*) and citrus brown-rot (*Pythiacystis citrophthora*) are also liable to cause serious losses during the curing process. To guard against losses by these diseases it is customary to immerse the fruit in some solution that will kill certain fungus spores that may be present, and at the same time clean the fruit of dust, spray deposit, sooty-mould fungus, scale insects, &c. Solutions recommended for this purpose, and which are used both in New Zealand and in other citrus-producing countries, are known as (1) borax solution and (2) borax-boracic acid solution. The former is made by adding 10 lb. of borax to every 20 gallons of water. The latter consists of $3\frac{1}{2}$ lb. borax, 5 lb. boracic acid, and 20 gallons of water.

This quantity of bath solution (20 gallons) is sufficient to immerse 4 bushels of fruit at the one time. The bath solution in both cases should be kept at a temperature of approximately 120° F., at which it has given reasonably satisfactory results in New Zealand. It is not safe to use water at a greater temperature than 115–120° for washing lemons. In this connection it is interesting to note that by experiment it has been found (Fawcett, 1922) that citrus brown-rot spores are killed and infection prevented by plain water at 115° for two minutes, or at 120° for one minute. Also, that any temperature less than 125° has little or only slight retarding influence on blue mould.

For most conditions under which lemons are cured in New Zealand, either of the above-mentioned solutions can be recommended. While the fruit can be and often is washed in these solutions it is considered an advantage to use two separate tanks, the first being used purely for cleaning the fruit. This practice helps to keep the solution clean and saves renewal costs.

It cannot be emphasized too strongly that any of the bath-solution treatments mentioned cannot be expected and should in no way be a substitute for careful handling to avoid injuries, as such treatments will prevent only a part of the decay. However, solutions other than the borax and borax-boracic acid solution are at times used with fairly satisfactory results. In cases where the cleaning of the fruit is the major consideration powdered soap and kerosene emulsion is at times used in place of the solutions mentioned, sufficient soap being added to produce suds. Although this solution is reported to be giving good results under certain conditions the writer does not know of it having been used in New Zealand, and therefore suggests that it be experimented with in a small way before being used for large quantities.

In cases where citrus brown-rot is present in an orchard, harvesting should on no account be commenced until the trees have been sprayed with bordeaux mixture at a strength of 4–4–40. This spraying will do far more towards the control of brown-rot than any treatment after the fruit has been picked.

Apart from assisting in the cleaning of the fruit and in the control of brown-rot the heating of the bath solution has not been proved to be

a very great advantage. In cases where these two factors have not to be contended with a cold copper sulphate solution often gives satisfactory results, the strength recommended being 1½ lb. copper sulphate to 1,000 gallons of water. After lemons have been washed in hot soapy water they are sometimes immersed in the copper sulphate solution. A number of other solutions are also used in other countries, many of which are of proprietary articles.

Storage Conditions.

To fully appreciate the various recommendations made herein an understanding knowledge of the effect of different storage conditions on the fruit is essential. The major considerations may briefly be described as follow:—

(1) The higher the temperature the lower the percentage of humidity, and the more ventilation provided in the curing-room the less time required to cure the fruit.

(2) The more rapid the curing the more liable the fruit will be to wilt excessively.

(3) Low temperature retards the curing process and delays colouring.

(4) High temperature, high percentage of humidity, and inadequate ventilation are conducive to the development of many fruit-rotting fungi.

It is therefore apparent that a middle line must be followed in regard to temperature, humidity, and ventilation. An even temperature also assists in bringing about the desired results. When green fruit is being cured a room temperature of approximately 50° to 60° F., with a relative humidity of 80 to 85 per cent., is considered most advantageous. In periods of hot, dry weather wet sacks placed on the floor of the curing-room will assist in maintaining these conditions. It is a common practice in certain other countries to have the curing-room under the main floor of the packing-shed, excavating about two-thirds the depth of the basement-room. This practice assists very considerably in producing an even temperature, although it appears doubtful whether the New Zealand climate would justify the adoption of the practice.

The more common practice in this country is to partition off a portion of the packing-shed for use as a curing-room, and as we are not subject to the intense heat of many other citrus-producing countries this practice can be expected to give reasonably satisfactory results. As good ventilation in the curing-room is of the utmost importance ventilators should be provided at close intervals on all four sides and at the floor-level, also in the roof or immediately under the eaves of the roof. On account of tree-ripe fruit requiring more ventilation than green fruit it is a great advantage to have the curing-room *divided into two parts.*

Containers.

The most suitable container to use in the curing-room is a shallow tray designed to hold one layer of fruit only. Trays 3 in. deep have proved to be suitable for this purpose. To permit of good ventilation the sides should be not more than 2 in. wide; the bottom should consist of boards about 1½ in. wide, and a ½ in. space should be allowed

between each board. The use of trays necessitates a considerable initial expense compared with the use of cases; however, owing to their many advantages trays unquestionably prove the most economical container of the two. The work of looking over the fruit during the curing process for the purpose of removing all fruit showing signs of decay is lessened very appreciably by the use of the trays, and the amount of waste by contact with decaying fruits is also considerably reduced.

Cleaning the Fruit.

All objectionable matter on the lemons, such as scale insects, sooty-mould, spray residue, dust, &c., should be removed by means of brushes while the fruit is in the bath solution. The type of brush to be used will be governed by the quantity of unclean fruit being handled. For very small quantities a hand brush is satisfactory; for larger packing-sheds a revolving brush, power-driven and secured to the side of the bath, has proved to be much quicker than the hand brushes. If the quantity of fruit handled warrants it a modern fruit-washing machine should be installed.

Great care needs be taken to see that the oil cells of the rind are not injured by the use of hard bristle brushes, otherwise the spores of fruit-rotting fungi may gain entry through such injuries and result in considerable loss of fruit. Damage of this nature is considerably lessened if the fruit is allowed to stand after picking from two to four days, according to the time of the year. This practice is strongly recommended.

Rotation of Operations.

Acting on the foregoing particulars the various operations connected with the curing of lemons should be executed in the following rotation:—

(1) On receipt of the fruit at the packing-shed it should be allowed to stand from two to four days, then washed and immersed for three to five minutes in one of the bath solutions mentioned, then allowed to dry on a draining bench.

(2) Hand-grade the fruit into six grades—three colour grades and each colour grade into two sizes—and place in trays; or make four grades if the silver grade is not being used.

(3) Stack the fruit in the curing-room, keeping every grade separate and allowing walking-space between every second tier of trays, and 2 in. between the sides of trays, so as to permit of access to every tray and to provide spaces for ventilation. The top trays of every tier should be covered to prevent excess of wilting; paper has been proved satisfactory for this purpose.

(4) Every tray should be examined periodically and all decaying fruit removed. These examinations in most instances should not be less frequent than every fourteen days during the months September to January, inclusive, and every twenty-one days during the remaining months of the year.

(5) As soon as sufficiently cured the fruit should be removed from the curing-room and graded, sized, wrapped, and packed in bushel cases.

Other Considerations.

The length of time taken to cure lemons varies according to the state of maturity at time of picking, size, and condition under which stored. For instance, a small tree-ripe lemon might readily be cured during the summer months in three to four weeks, whereas a large green lemon harvested in the winter will often take two months and sometimes longer before being fully coloured and cured.

Loss through decay is invariably greater in tree-ripe fruit than in green fruit, consequently every effort should be made to hasten the curing process of all coloured fruit. During the months of the year when rot is most troublesome this should be done even at the expense of a certain amount of wilting of the fruit, by giving the utmost ventilation, and also by heating the curing-room during cold weather. With green fruit great care needs to be taken to see that the fruit is not fully cured before the true lemon colour is assumed, otherwise the colouring process is greatly delayed and the fruit shrinks excessively. This must be guarded against principally by restricting the amount of ventilation. As high temperature is associated with rapid curing, kerosene-burning heaters can often be used to advantage in curing-rooms during cold weather, especially on occasions such as when the demand for cured fruit is greater than the supply.

Careful handling of the fruit to avoid the slightest injury is probably the greatest factor in the prevention of decay. Injuries may originate in many ways, including stem punctures, bruises, finger-nail scratching, injury by secateurs, pulled fruit, &c. The following suggestions are made for the prevention of such injuries:—

(1) Pick all fruit by means of small secateurs designed for this purpose.

(2) Sever the stem as close to the bottom of the fruit as possible, but without injuring the bottom. Two cuts are often necessary for this purpose, the first to sever and the second to shorten the stem.

(3) Avoid dropping fruit into picking-bags or boxes, heaping of field boxes, pressing picking-bag against ladder or limbs, and careless emptying of picking-bags into boxes.

(4) Wearing gloves when picking, sorting, or packing; or, as an alternative, see that finger-nails are kept extremely short.

When lemons are being cured in a building that has not been specially constructed for that purpose difficulty may be experienced during the hot summer months in preventing excessive wilting if the fruit is stored in trays. Under such conditions it is advisable to store the lemons in bushel cases during the hotter months of the year.

Rape Kale for Sheep.—A Fields Division officer reports that greatly differing opinions of the value of rape kale are being given by experienced sheep-breeders in the Manawatu district. This seems to be due to the fact that two very diverse types of this kale are being sold under the one name. One of these is similar to a loose cabbage in habit of growth, and does not differ greatly in appearance from ordinary rape except in that it has a longer stem portion from which leaves arise. The other is of low habit, dark colour, and distinctly crinkled leaves. For the feeding of lambs the former type is thought highly of by breeders, who say it does not cause scald as does ordinary rape. The latter type is not favoured, and it is said the lambs do not eat it.

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

J. A. BRUCE, Inspector of Fertilizers, Department of Agriculture, Wellington.

I. BASIC SLAG.

VERY marked expansion has taken place of late years in the importation of basic slag from Europe, concessions in freight rates by shipping companies having been an important factor in encouraging its use. Evidence of the successful use and popularity of the material as a fertilizer is afforded by the fact that close on 600,000 tons have been brought to New Zealand from across the world during the past twenty years, of which 463,000 tons have been imported since 1921. The area of grassland in the Dominion top-dressed with basic slag was 619,935 acres in 1928–29 and 651,494 acres in 1929–30.

QUALITY OF SLAGS ON THE NEW ZEALAND MARKET.

A question frequently asked at the present time is, What are the qualities and specifications of the slags sold throughout the Dominion? Before going into this subject in detail, one may say from the information available that the qualities generally are of a high standard. The phosphoric acid content of the thirty-three brands registered under the Fertilizers Act, 1927, ranges from 15 to 20 per cent.; the fineness of grinding varies from 80 to 90 per cent., although the majority are guaranteed 80 per cent.

The slags registered may be broadly classified as follows:—

Table 1.

Number of Brands.	Process of Manufacture.	Grade.		Origin.	Average Percentage of Phosphoric Acid (insoluble in Water).	Fineness of Grinding.
		Description.	Formula.			
			Per Cent.			
1	Open hearth	Medium	15	England	15	Averages about 80 per cent.
25	Bessemer ..	High ..	17/20	Belgium	17	
2	,, ..	,, ..	18/21	,,	18	
5	,, ..	,, ..	20/22	,,	20	

NOTE.—A few of the Belgian brands are of German and French origin.

In advertising these slags for sale it is customary for traders to adopt the designations 15%, 17–20%, 18–21%, and 20–22% for the particular brand they may be selling. This method of describing the essential constituent (phosphoric acid) is often puzzling to prospective buyers, and requires some explanation. A grade formula such as 17–20% merely emphasizes the approximate range of the phosphoric acid present in the slag.

Different shipments of the same brand may vary in quality from time to time—that is, on one occasion the phosphoric acid content may be 17 per cent., on another 18 per cent. When the slag is sold, however, a definite guarantee of the correct percentage must be shown on the invoice certificate, correct within the limits of error. The Fertilizers Act protects the buyer by providing for an

invoice certificate of analysis to be handed over to him on delivery of any quantity of 5 cwt. or more of any fertilizer he has contracted to buy. Owing to it being somewhat difficult to keep the ingredients of a fertilizer exactly to the guaranteed percentages, limits of error are allowed for such statements in respect of the essentials nitrogen, phosphoric acid, and potash. In the case of a statement of the amount of phosphoric acid in slag, the limit of variability is prescribed as 1 per cent.

When considering this rather liberal margin of 1 per cent. error, a point which must be borne in mind is that basic slag is the *by-product* of the manufacture of steel in blast furnaces. It, therefore, cannot be considered in the same category as a synthetic *main product*—like mono-ammonium phosphate, for instance—which can be manufactured to a uniform and almost exact formula. Steel manufacturers naturally aim at producing good-quality steel, and cannot be expected to devote attention to obtaining completely uniform composition in a residual material which is not their direct object of manufacture. It would be entirely unprofitable, or perhaps even disastrous from their point of view, to attempt to alter a process of steel manufacture in order to secure a marketable slag with a fixed percentage of phosphoric acid. (Preface by Sir John Russell to "Basic Slags and Rock Phosphates." G. S. Robertson.)

New Zealand's main source of supply of slag is now practically limited to a comparatively few Belgian steel works. Several merchants here competing for the sale of slag may at times be obliged to procure parcels of the same grade of material from one or perhaps two factories only, and this to some extent accounts for the composition of a large proportion of the slag on the New Zealand market being similar, although the actual brands on the bags may be quite distinctive. New Zealand merchants are able to arrange for their own particular brands, and not necessarily those of the manufacturers, to be inscribed on the bags. Thus it will be seen that out of the thirty-three brands registered under the Act there are only four grades to choose from—15%, 17–20%, 18–21%, and 20–22%.

The mills in Belgium, where slag is finely ground, bagged, and made ready for despatch, fortunately supply local fertilizer firms with high-grade Bessemer slag reasonably constant in composition. Tests conducted over a period of several years in the chemical laboratory of the Department of Agriculture substantiate this fact. It is also an additional satisfaction to know that, in spite of the very keen demand and the rapidly declining production of Bessemer slag, New Zealand firms have been singularly alert in negotiating with overseas manufacturers and their agents for regular shipments of the desirable high-grade material.

Belgium, including Luxembourg, in 1929 exported 1,224,000 tons of slag, of which 615,000 tons were shipped to Germany and 241,000 tons to Holland. New Zealand during the year 1929–30 imported 94,000 tons, principally from Belgium. Germany not only produces 1,500,000 metric tons (metric ton = 0·9842 ordinary ton), but imports an additional 1,000,000 tons from neighbouring steel-producing countries. Great Britain in 1929 exported 55,000 tons.

Distance from railway, freight, storage, haulage, and handling are exceedingly important factors in connection with the use of slag, and, in fact, of any fertilizer; and where a great deal of the inland transport is over bad roads (by pack-horses in some instances) it is obvious that the fertilizers employed should be of as high a grade as possible. High-grade fertilizers save manufacturing, bag, and distributing costs, thereby making labour more productive. To ship low-grade slags to a country like New Zealand would not be an economic proposition, unless they could be sold at ridiculously low prices to fertilizer-users in the immediate vicinity of ports of discharge. Needless to say such a course is not likely to be followed at present.

Considerable attention was focussed on the question of the quality of our imported fertilizers during the years 1927 and 1928. Systematic examinations of samples taken from large consignments of slag exported from Europe to this country were arranged for in London. With very few exceptions the indications were, that we were receiving good-quality slags, with phosphoric acid content varying between 15 and 20 per cent.; with fineness of grinding either conforming to or above the regulation minimum of 80 per cent.; and with satisfactory guarantees of citric-soluble acid. The moisture content, which is always considered to be important in connection with the distribution of any type of fertilizer, was found to be very low—under 0·5 per cent. in almost every sample examined.

The chemical examination of informal samples sent in by purchasers and Departmental officers during the past two years has failed to reveal the presence on our market of either low-grade or fortified slags (*i.e.*, adulterated with ground rock-phosphate). Moreover, close supervision of the registration and sale of fertilizers since the Fertilizers Act, 1927, came into operation has sufficiently demonstrated that certain brands of inferior character on sale in some other countries did not find their way into New Zealand. (All brands of fertilizers must be registered annually with the Director-General of Agriculture.)

Effect of Changes in the Manufacture of Post-war Slags.

In Great Britain, where the Siemens open hearth process of steel manufacture has taken the place of the Bessemer process, the buying and selling of slags calls for skill both in distinguishing and in calculating the values of the many locally produced and imported grades on the market. The following table shows the main types in use in Great Britain at the present time:—

Table 2.

—	Type 1.	Type 2.	Type 3.*
Percentage of phosphoric acid	16 to 18 ..	8 to 17 ..	8 to 15.
Percentage of total phosphoric acid soluble in a 2-per-cent. solution of citric acid	80 or more	80 or more	40 or less.
Process of production ..	Bessemer	Open hearth	Open hearth with addition of fluospar.

* Mainly sold at fixed price per ton near works.

That New Zealand will in the future draw larger supplies of slag from British steelmakers is highly probable. There is, furthermore, some assurance of good-quality grades being procurable by means of careful selection. An interesting extract from the seventh interim report of the British Permanent Committee on Basic Slag, 1930 (Sir John Russell, Chairman), says, "In this country the Bessemer process of steel manufacture is not at present used and Bessemer slags on the British market are entirely of foreign origin. For some time the replacement of the Bessemer process by the open hearth process caused deterioration in the quality of basic slags, both in phosphoric acid content and in citric solubility. Improvements have been gradually introduced, and the greater portion of the basic slag ground in this country is now free from fluospar and is of high citric acid solubility. In our experiments open hearth slags of high solubility in citric acid were as effective as the old Bessemer slags and more effective than open hearth slags of less than 40 per cent. citric solubility, the same amount of phosphoric acid being given in all cases."

In the light of present agricultural conditions such statements will be received with satisfaction. Improvements in quality and better methods of evaluating slags in Great Britain may pave the way for further trade expansion, assuming, of course, that the demand for steel will increase when general trade conditions improve.

The opinion is sometimes held by farmers and others that slags on sale before the war in this country were much better in quality and cheaper than those imported to-day. Records in the possession of the Department of Agriculture do not support this view. In 1906 and 1908 slags containing 8 to 17 per cent. phosphoric acid were imported and sold at slightly higher prices than those ruling to-day.

The bringing into operation of the important regulation under the Fertilizers Act prescribing a minimum standard of fineness of grinding has certainly had the desired effect of ensuring for the consumer a very much better ground article than formerly. There has been no evidence of retrogression, either in the quality of slag or of any other type of fertilizer in New Zealand, since the Fertilizers Act of 1927 was put on the statute-book.

The Lime in Slag and its Value.

This subject offers scope for much investigation. Opinion is divided among experts as to whether great value attaches to the lime in slag or not. Professor Hendrick, of Aberdeen, a noteworthy authority on lime questions in agriculture, has commented upon the position as follows: "Slag is alkaline in reaction and supplies a little lime to the soil. The amount of lime it supplies is often exaggerated, and some are apt to suppose that the use of a few hundredweights of slag to the acre does away with the necessity for lime. This is by no means the case. Ordinary basic slag contains only 2 or 3 per cent. of free lime, and the total amount it can supply in a form suitable for neutralizing acids does not amount to more than 10 to 15 per cent. Generally speaking, one may say that a dressing of 10 cwt. of basic slag does not supply as much available lime to the soil as would be given by 2 cwt. of good-quality burnt lime."

The Permanent Basic Slag Committee in its eighth report, 1930, has thrown light on the matter: "It is difficult to discriminate between the direct nutritional effect of the phosphoric acid and the indirect effect due to the basic material supplied in the slag." The report goes on to state that a preliminary series of pot experiments suggests that basic slag is about as effective as an equal weight of calcium carbonate for liming purposes, though it may well happen that the stimulation of clovers and other changes in vegetation may cause a greater loss of lime than that actually supplied in the slag.

Dr. E. Vanstone (Some Experiments on Basic Slags, Abstracts of Papers on Agricultural Research, 1927) is reported as follows: "The lime present in basic slags is a factor of great importance; it is present in large quantity as di-calcium silicate, which is an important source of available lime."

Other Notable Constituents in Slag.

Until more experimental evidence is available regarding the fertilizing value of various other mineral elements in addition to phosphate and lime in slag, very little can be said at the present juncture. There appear to be many points concerning the remarkable efficacy of slag on certain classes of soils which are not yet understood. The usual amounts of the principal ingredients in slag which are held to have no market value and therefore do not come within the scope of the Fertilizers Act are: Silica, 16 to 18 per cent.; magnesia, 6 to 8 per cent.; iron, 8 to 10 per cent.; manganous oxide, 3 to 4 per cent.; alumina, 3 to 4 per cent.

Perhaps the time is not far off when fertilizer practice will give full recognition to the importance of such mineral elements as iron, manganese, and magnesia. The combinations carrying these elements in slag, although possibly not in the best form for assimilation by plants, cannot be entirely regarded as forms of diluent or worthless matter. Systematic research has proved certain mineral elements, hitherto regarded as unimportant, to be indispensable to the growth and function of plants under certain conditions of the soil. Small proportions of manganese and magnesia are already beginning to find their way into the fertilizer-bags in more than one American State. The United States Department of Agriculture has shown that manganese sulphate improves growth greatly when introduced in an alkaline soil.

In our own country B. C. Aston (this *Journal* for April, 1929) in discussing the cure of iron-starvation (bush sickness) has drawn attention to the desirability of top-dressing bush-sick pasture with phosphates containing iron as one of the remedial measures for controlling the trouble. Basic slag, being the only commercial phosphate containing iron in appreciable amount, is recommended for the purpose, although it is further pointed out that a mixture containing equal parts of slag and superphosphate gives the best results. In the Moutere Hills district, Nelson, a noted fruitgrowing area, orchardists are of the opinion that the iron in basic slag induces more colour in the apples.

Basis of Sale of Slag in New Zealand.

TOTAL PHOSPHORIC ACID.

As the analysis supplied by the seller is the best guide to rely on when slag is being bought, the Fertilizers Act specifies as the legal warranty the percentage of insoluble phosphoric acid—*i.e.*, soluble in mineral acid but insoluble in water. This simply means the statement recorded by the vendor in an invoice certificate to show the purchaser the plant-food value of the material he is buying.

In basic slags the phosphoric acid exists as peculiarly complex phosphates of lime, possessing different properties from the less available so-called tricalcic phosphate of raw mineral phosphate and the soluble monocalcium phosphate of superphosphate. According to Dr. E. Vanstone, in high-soluble slags the phosphate is present as silico-phosphate. In low-soluble slags a basic tetracalcic phosphate is present. Commenting on tricalcium versus rock phosphate in the *Commercial Fertilizer Journal*, March, 1931, T. S. Buie, Field Agronomist, Superphosphate Institute, Washington, says, "Confusion of the tricalcium phosphate with the phosphatic compounds of rock phosphate leads to erroneous conclusions regarding the value of the former material. While in the past the phosphorus of rock phosphate has been considered to be [combined as] a tricalcium phosphate, recent investigations by the Bureau of Chemistry and Soils (U.S.A.) prove conclusively that such is not the case. The phosphorus of phosphate rock is [in combination as] a complex compound having the empirical formula 3 $Ca_3(PO_4)_2$, CaF_2, and it has physical and chemical properties entirely different from those of tricalcium phosphate, the empirical formula of which is simply $Ca_3(PO_4)_2$."

The use of a fertilizer containing so much phosphoric acid does not necessarily mean that an acid is being added to the soil. "Phosphoric acid" is merely a standard or conventional expression of plant-nutrient value applied to phosphatic fertilizers. As a matter of fact, slag is a distinctly alkaline or anti-acid fertilizer.

In common with other classes of fertilizer, the buying of slag should be based on what is stipulated in the invoice certificate, without depending entirely on descriptions in trade propaganda. From time to time slags are advertised to contain so much phosphate instead of phosphoric acid. If stated in this way the figures do not coincide with the statement in the invoice certificate, and in consequence may lead to misunderstanding. To enable the value to be assessed in terms of phosphoric acid, it is necessary to realize that "phosphoric acid" has approximately two and one-fifth times the value of phosphate (tricalcic phosphate). The phosphoric acid—and this applies to other phosphatic fertilizers as well—may be found by dividing the figures expressed as phosphate by $2\frac{1}{5}$, or, to be more precise, by 2·18. Conversely, the amount of phosphate can be reckoned by multiplying the percentage of phosphoric acid by $2\frac{1}{5}$ or 2·18. A slag advertised to contain 37 per cent. of total phosphate would be of the same value as slag advertised to contain 17 per cent. phosphoric acid.

A statement of some equivalents of phosphoric acid in total phosphate and synonymous terms is given in Table 3. This will be helpful to buyers who wish to ascertain the percentage of phosphoric acid from a trade advertisement or list expressing plant-food in terms of phosphate.

Table 3.

Plant-food expressed in terms of Phosphoric Acid.	Plant-food expressed in Terms of Total Phosphate, Phosphate, or Tricalic Phosphate.
Per Cent.	Per Cent.
1	Equivalent to 2·184
7	,, 15·28
8	,, 17·46
9	,, 19·64
10	,, 21·82
11	,, 24·00
12	,, 26·19
13	,, 28·37
14	,, 30·56
15	,, 32·74
16	,, 34·94
17	,, 37·13
18	,, 39·31
19	,, 41·50
20	,, 43·68
21	,, 45·86
22	,, 48·05

Examples: (1) A superphosphate advertised to contain 44–46 per cent. phosphate = approximately 20–21 per cent. phosphoric acid. (2) A slag containing 20–22 per cent. phosphoric acid = approximately 44–48 per cent. phosphate.

FINENESS OF GRINDING.

Another warranty required for slag is the amount of the article which will pass through a prescribed sieve. To determine fineness of grinding, a sample of known weight is sifted through a screen containing 10,000 openings of equal size to the square inch, the amount coming through being weighed. In a well-ground sample this amounts to 80 per cent. or more. Vendors are liable to prosecution under the Act for the sale of a slag which does not come up to the prescribed standard of 80 per cent. fineness. The margin of error allowed for the fineness guarantee in an invoice certificate or registration statement is 2·5 per cent.

Although the mechanical process of grinding does not alter the composition of slag, or in any way provide for constituents to be regulated by manipulation, the fineness is of the utmost importance for assisting distribution and in increasing the solubility of the slag in the water of the soil. The future trend is for still higher standards of fineness; the existing standard of 80 per cent. may possibly have to be altered in the course of a few years.

PERCENTAGE OF CITRIC-SOLUBLE OR AVAILABLE PHOSPHORIC ACID.

The question whether this specification should be required to be given in invoice certificates has been a subject of controversy for many years. It is asserted by some that the manurial value of both basic slag and raw mineral phosphate mainly depends upon a high percentage of their phosphoric acid being soluble in a dilute solution of citric acid. On the other hand, the contention is put forward that there is no foundation for the belief that conventional citric-solubility tests are in any way

reliable measures of the presence of phosphate in a readily available condition for promoting the growth of plants, and are accordingly of no assistance in determining the value of either basic slag or raw mineral phosphate.

The Fertilizers Act meets this rather awkward controversial situation by making it optional for sellers to declare the percentage of citric-soluble phosphoric acid in statutory statements. About 3 per cent. of the vendors registered under the Act give guarantees of the citric-soluble phosphoric acid in their registrations. If a guarantee is given the figure stipulated must be determined by the test laid down by regulations under the Act. A standard method for estimating the citric solubility of phosphoric acid is absolutely necessary. Almost any solubility figure can be obtained by varying the strengths of citric-acid solutions or by using smaller quantities of fertilizer in conducting tests of this nature.

Many people nowadays are in favour of citric-solubility guarantees being adopted as the main basis of sale for slags and raw ground phosphates, but there is an obvious need for a clearer knowledge of the whole position. In the words of one specialist, citric-solubility figures have a descriptive rather than a precise value, and this seems to be a reasonable way of putting it.

The Basic Slag Committee refers to the matter by mentioning in its seventh report that the results of their experiments up to the year 1928 had been briefly summarized, and that a careful perusal of the data collected conveyed the impression that nothing very definite had emerged, especially as to the value of the citric-acid test. Another extract from the same report reads, "The pot experiments and laboratory work appear to be leading the investigators to the conclusion that some other test than the citric-acid one may be a better measure of the availability of the phosphoric acid in slags."

In view of the differences in opinion among experts as to the value of citric-solubility tests, and the fact that citric-solubility figures are very rarely guaranteed in invoice certificates, farmers would be well advised not to concern themselves with the many and varied claims in propaganda referring to citric-solubility figures obtained by so-called modified tests. Unfortunately there is no clause in the Fertilizers Act which can be exercised to deal with misleading statements in fertilizer advertisements and circulars.

Dr. Tocher, the well-known Scottish chemist, in summing up his lengthy investigations (*Journal of Agricultural Science*, Vol. 12, 1922) of various methods for estimating citric solubility, emphasizes that the only practical tests of value of insoluble phosphatic fertilizers from the agricultural standpoint are: (1) Total phosphatic content, (2) degree of fineness of grinding, (3) freedom from injurious substances and substances inhibiting plant-growth.

Further research will prove whether this is the correct viewpoint or not. The New Zealand Fertilizers Act covers the ground as far as the above three tests are concerned. When it is proved conclusively that citric-solubility tests can be safely relied on the question of the enforcement of guarantees of citric-soluble phosphoric acid in invoice certificates and registration statements will no doubt receive attention.

The final and most important of all tests for any kind of fertilizer is what it will do when actually applied to the land.

The following is a comparison of citric solubilities of phosphate in typical samples of basic slag, and Tunisian and Moroccan phosphate, as obtained by the official test :—

Table 4.

—	Bessemer Basic Slag.	Tunisian Phosphate.	Moroccan Phosphate.
	Per Cent.	Per Cent.	Per Cent.
Total phosphoric acid	17·4	26·2	35·2
Citric-soluble phosphoric acid ..	15·9	10·7	11·2
Total citric solubility.	92	40	32

(Series to be continued.)

THE BLUE STEM-BORER OF RAGWORT (*HOMOEOSOMA VAGELLA*).

W. Cottier, M.Sc., Entomology Section, Plant Research Station, Palmerston North.

The caterpillar of the moth *Homoeosoma vagella* Zell.* has been reported as doing considerable damage to ragwort in different parts of the North Island. An investigation was carried out in Taranaki during 1929 to ascertain the extent and nature of the damage done, and also to determine whether or not the insect promised to aid in the control of the weed.

A brief history of the insect in New Zealand may not be out of place here. First of all, it may be said that the genus *Homoeosoma* is a cosmopolitan one, usually attacking the flower-heads of Compositæ. Thus *H. nebulella* is a serious pest of sunflower-seeds in Russia and Rumania. *H. vagella*, however, is noted as a borer in the pithy stem of ragwort (one of the Compositæ), the flower-head being apparently undamaged. *H. vagella* was mentioned under the name of *H. anaspila* by Meyrick (1901), who himself took the moth in the North Island and who received further specimens from Christchurch. Hudson (1928) says that the insect has been taken at Invercargill and Wellington, while reports received by this Station show that it is fairly well distributed over the ragwort areas of the North Island. When he collected in New Zealand (from about 1879 to 1886) Meyrick, in his note, says the species seemed to be very scarce, so that it must have increased enormously in later years—certainly it is abundant in ragwort-infested areas to-day. Again, under the name *H. anaspila* it is mentioned in "Index Faunæ Novæ Zealandia" (1904). Since the first definite record of ragwort in New Zealand was made, in 1874, it

* According to Mr. G. V. Hudson, of Wellington, the insect we have been calling *Homoeosoma vagella* in New Zealand should really be known as *H. farinaria* (*i.e.*, the one Meyrick called *H. anaspila*). *H. vagella* is very common in Australia. It seems likely that we have both species in New Zealand boring into the pithy ragwort-stem. Miller (1929) also mentions the two moth stem-borers.

would appear that this insect came to regard the introduced ragwort as a host, and as time went on increased its attack till the infestation reached its present-day form.

Description of the Insect and its Work.

Although no eggs have been found, from the manner of entrance of the caterpillar into the flower-stalk of the ragwort these appear to be laid in the axils of the leaves. When the young larva is hatched it immediately starts to bore into the flower-stem, leaving a small heap of sawdust-like refuse (frass) at the entrance to the burrow. The particles of this refuse seem to be held together by some fine thread-like substance. Once inside the stem, the larvæ make their way downwards through the pith towards the crown of the plant. Besides boring in the pith, the larvæ frequently eat round the outside of the flower-stalk at its junction with the crown. The destination of the borers seems always to be in the direction of the pithy crown, which sometimes if in sufficient numbers they will hollow out. Regarding the numbers of caterpillars in one plant, it is common to find twenty or more, a borer having entered the stem at the axil of almost every leaf.

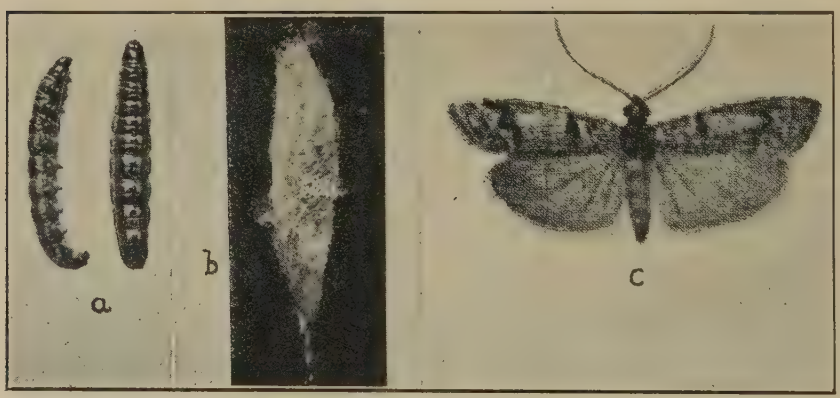

FIG. 1. HOMOEOSOMA VAGELLA.

(*a*) Larva, which does the damage to the ragwort-stem; (*b*) pupa in its cocoon; (*c*) moth. All enlarged.

Larva or Caterpillar (*Fig. Ia*).—This is the stage which does all the damage. The full-grown larva is approximately $\frac{7}{10}$ in. long, plump, and of a bluish colour. The caterpillar, viewed from above, has three dark stripes running the whole length of the back, the middle stripe being narrower than the other two. The head is of medium size and is black. There is a pair of legs on each of the first three segments behind the head, and a pair of prolegs on segments seven to ten, counting the head as the first segment. There is also a pair of prolegs on the last segment. The body is sparsely clothed with fairly long hairs. Younger forms of the larvæ are usually much lighter in colour, but with the same dark stripes.

Pupa (*Fig. Ib*).—Pupation takes place inside the hollowed-out stem, apparently at any part of it, and not uncommonly the pupa may be found on the outside of the stem in a sheltered position. The distance of the pupa from the crown of the plant depends on whether the caterpillar entered the stem high up or not. This pupa is of a pretty blue or blue-green colour, and is surrounded by a tough white envelope distinctly longer and broader than the caterpillar.

Moth (*Fig. Ic*).—The expansion of the wings is approximately 1 in. The body is rather stout. The forewings are narrow and of a yellowish-white colour with grey markings. The hind wings are considerably larger than the forewings, of a dusty greyish-white colour and fringed posteriorly. The perfect insect usually appears from January to March.

Field Investigation in Taranaki.

The localities visited were Hawera, Stratford, and New Plymouth. On a visit in February, 1929, the following observations were made:

HAWERA.

No. 1 Farm: In parts of this land the caterpillar was very prevalent, in some paddocks the infestation being 100 per cent. According to the owner, one of the paddocks infested was very thick in 1928 with old ragwort plants, and it was here that he first noticed the caterpillar at work. Attention was drawn to it by the fact that several of the plants began to die, and on examination the larvæ of *H. vagella* were discovered boring in the pith of the flower-stalk of the ragwort. In 1929 there was not a sign of any old plant. However, there were evident on this site plenty of young plants from the last season's seed. In another paddock, where the infestation was 100 per cent., the ragwort appeared to be growing vigorously, with one or two plants showing signs of dying off. However, these latter contained no more caterpillars than the apparently healthy plants. Further, the ragwort was only slightly thinner than it was in 1928, but seemed to be disappearing. Thus, although the evidence gathered here seemed to be in favour of the insect, the ragwort was evident everywhere in full bloom.

No. 2 Farm: The plants examined here were much smaller, but the infestation would be between 80 and 90 per cent. Notwithstanding this, the plants seemed to be vigorous enough and plentiful.

No. 3 Farm: The caterpillar was found here also in considerable numbers, and, further, it was boring in the fleshy leaf-stems of young plants from the last seeding. This latter was considered a fact of the first importance.

STRATFORD.

No. 4 Farm: On this holding the caterpillar was found in considerable numbers, about 90 per cent. of the ragwort plants being attacked in the worst infested patches. Nevertheless the ragwort was growing vigorously.

No. 5 Farm: The insect was present to the same extent, but here an interesting thing was noticed. On this farm there were two paddocks a few hundred yards apart, both containing ragwort which had been cut once. In one, infestation by the caterpillar was 100 per cent. and in the other only 40 per cent. In the former paddock

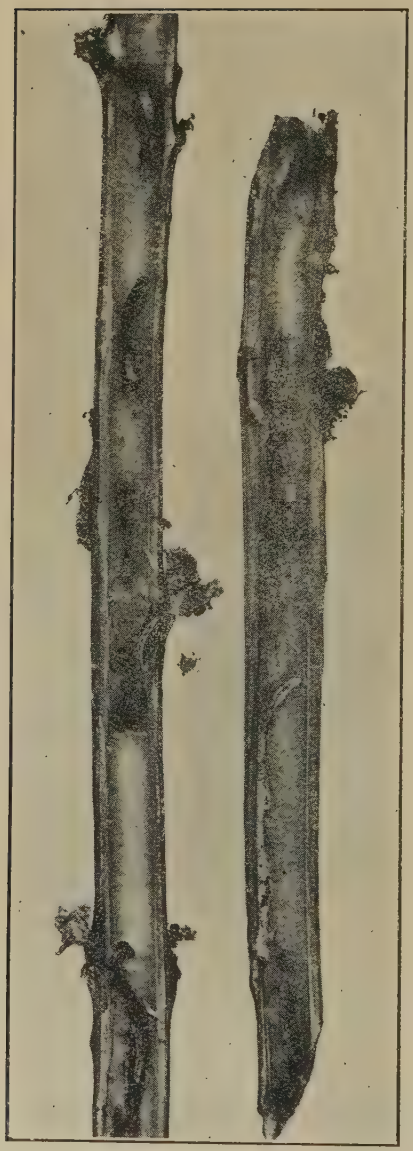

FIG. 2 (LEFT). SHOWING THE CATERPILLAR BORING IN BADLY INFESTED STEMS.
Note the frass at the entrance to the burrow.

FIG. 3. EXTERNAL APPEARANCE OF AN INFESTED STEM.
Again note the frass at the entrance to the burrows in the axils of the leaves.
[Photos by H. Drake.

there was no secondary growth of ragwort, the plants having rotted at the crown. In the latter the secondary growth was as vigorous as ever. On this farm the caterpillar was found boring in seedling plants.

NEW PLYMOUTH.

No. 6 Farm: Here infestation was about 60 per cent., and apparently was having very little, if any, effect in reducing the weed.

Nos. 7 and 8 Farms: These are two farms somewhat to the north of New Plymouth, and on both these properties the caterpillar was present in about 60 per cent. of the plants, but as far as could be judged was not controlling the ragwort.

LATER EXAMINATIONS.

Early in May, 1929, on another visit to Taranaki, the writer examined again some of the ragwort areas mentioned above. Everywhere the amount of growth made by seedling plants was remarkable, and indeed discouraging if one were to look to *Homoeosoma* for a control. Where the caterpillars had infested 100 per cent. of the plants of the previous generation, a very luxuriant growth of young ragwort was springing up.

Still later, in August, 1929, these areas were again inspected and the following observations made: There was plenty of young growth in the paddocks where the weed was said to have been killed out by the insect, the young plants being very vigorous. Apart from this new growth, the only green ragwort plants were a few with short flower-stems in full bloom. The caterpillars were boring in these and in the fleshy basal portions of the leaf-stalks of the seedling plants. They were also found in the stemmy parts of old plants that had begun to put forth the new season's growth, so that apparently the insect passes the winter in the larval stage.

Conclusion.

From the data gathered it may be said that *Homoeosoma vagella* does considerable damage to ragwort; but unfortunately such damage does not extend to the flower-head, so that the plant can seed just as well as ever. Tests of seed from infested and healthy plants showed no difference in germinating-power, so that the processes of reproduction and distribution of the weed would not be hampered. Since this is the case the economic importance of *H. vagella* is very small, and its utility in a campaign for control of the weed is almost negligible. Also, Miller (1929) states that the moth is itself controlled by parasites, so that its usefulness is still further reduced.

The writer is indebted to Mr. G. V. Hudson, of Wellington, for much of the description of the insect.

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A SIMPLE WOOL-TESTING OUTFIT.

DETECTION OF HAIR IN THE FLEECE.

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IN an article entitled "Medulla in Wool," published in this *Journal* for February last, the writer described a new simple test by means of which those slight amounts of hairiness in wool which are difficult or impossible to see with the naked eye may be infallibly detected. Since then further work has been done in developing a simplified testing equipment for farm use, so that the test may now be applied by any one without previous experience, working either in the woolshed or yards.

The technique of the test is still the same, and it is the object of this note to describe the new equipment and to draw attention to several precautions which, after further field experience, it seems necessary to emphasize. The essence of the test is that pure wool when immersed in benzol becomes almost invisible, whereas hairs—*i.e.*, medullated fibres—remain bright and chalky in appearance. The principle involved applies to all New Zealand wools, from the strongest to the finest, and also to the examination of tops. The essential equipment now consists of (1) a shallow iron tray 10 in. by 8 in. by $\frac{3}{4}$ in. deep, porcelain-enamelled black on the inside; (2) a rectangular piece of $\frac{1}{4}$ in. plate glass 9 in. by 7 in., with rounded edges and corners; and (3) a supply of benzol. Cheaper means of blackening the inside of the tray have been tried, but none with lasting satisfaction, since the benzol softens and removes all ordinary enamels and lacquers.

The quality of the benzol is vital to the success of the test. Unfortunately, some grades of commercial benzol are not pure enough for the purpose, and, in order to ensure that the correct material is used, Massey Agricultural College has arranged to supply tested benzol in quart and $\frac{1}{2}$-gallon tins at cost price.

PROCEDURE.

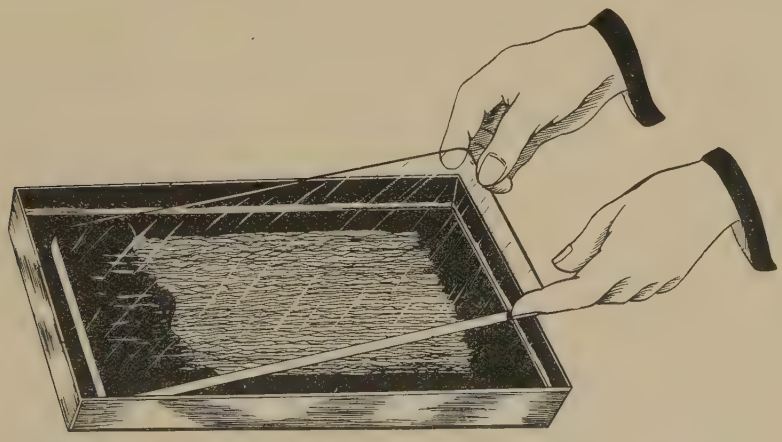
The selected lock of wool is scoured in petrol and teased out in the manner described in the first article. The lock is then laid in the testing-tray, partly filled with benzol, and is covered with the glass plate, care being taken not to include any air bubbles among the fibres. This is best done by first lowering one end of the plate into the benzol, and then gradually lowering the other end (see illustration). Experience will indicate best the amount of benzol to use; it is advisable not to use so much that it flows over the upper surface of the glass plate when that is lowered into position. The same benzol can be used repeatedly so long as it has not become cloudy or contaminated with petrol.

The lock of wool, immersed in benzol, is then seen against the black base of the testing-tray. Viewed in this manner the pure wool is not always absolutely invisible, especially when the teasing-out has not been sufficient, because of the added effect of a large number of fibres together, each reflecting a small amount of light.

Medullated fibres, however, stand out bright and chalky, and are easily distinguished from the silky transparent appearance of the pure wool. Very little experience is needed before this distinction can be made with certainty and confidence.

It must be emphasized that the successful application of the test depends on the strict observance of the precautions detailed later. While in the case of the finer wools the worker can hardly fail to achieve success, yet in the case of the stronger wools considerable care has to be exercised, especially in thoroughly teasing out the samples.

It must not be thought, however, that the introduction of this test may lead to the encouragement of the finer wools at the expense of the stronger wools. Provided that the precautions laid down are strictly adhered to, the strongest of pure wools are just as effectively distinguished from hair as are the finest, and the breeder can select for pure wool of whatever count he desires to grow.



LOWERING THE GLASS PLATE ON TO THE WOOL IMMERSED IN BENZOL.

The writer has occasionally encountered, more especially in the strong wools, a type of non-medullated fibre which is distinctly visible under the test. These fibres acquire in the benzol a pale smoky appearance, which is found to be due to the presence throughout the fibre of very minute air cavities, quite different from those occurring along the centre of medullated fibres. Whether this type of fibre is desirable or not has not yet been ascertained, but once the worker is aware of its existence, no difficulty will be experienced in distinguishing between its appearance and the bright chalky appearance of true medulla.

The ideal conditions for observation are supplied by bright light from one or more sides and no direct light from above. These conditions have often been achieved by working in the wool-shed near an open door, always facing the light while examining the wool in the testing-tray. It is essential to keep the tray out of direct sunlight; therefore, if the work has to be done out of doors on a bright day, place the tray in a shady position.

This test should prove especially valuable to breeders of stud sheep, and it is anticipated that it will eventually become the basis of a system of certification whereby the freedom from hairiness of tested stud sheep may be guaranteed. The test is very critical, and it is more than likely that until it has been in use for many years it will not be feasible to condemn every ram showing only slight traces of medulla. But although there may be this economic limit to the immediate rejection of all animals not standing up to the test, it will prove a valuable scientific tool in the hands of the breeder, in that he will have the advantage of knowing more exactly what he is using for breeding purposes.

Precautions.

(1) The liquid used for the test—benzol—is obtained from coal during the manufacture of coal tar and gas, and it is entirely different from benzine, petrol, or motor-spirit; petrol is quite useless for the test, since pure wool is almost as visible when immersed in it as is hair. Petrol must only be used for cleaning the wool preparatory to testing.

(2) Be sure to obtain benzol of the necessary purity.

(3) Benzol and its vapour are highly inflammable, and the same care should be exercised as with the storage and use of petrol. (N.B.—Do not smoke while carrying out the test.)

(4) Benzol evaporates rapidly, and should be kept in a well-stoppered container.

(5) Be sure to dry the lock after scouring in petrol, otherwise the benzol will become contaminated with petrol and be no longer suitable for the test.

(6) It is essential to the efficiency of the test that the testing tray and glass should be kept clean and free from the small amount of wool grease that inevitably gets into the benzol in spite of the preliminary scouring in petrol. The tray and glass should therefore be wiped clean and dry immediately after use. If left it becomes much more difficult to remove the grease. Clean and polish the glass plate before each test.

(7) Too much emphasis cannot be laid on the necessity for very carefully teasing out the lock (before immersion in the benzol) into a thin uniform layer, eliminating bundling of the fibres as much as possible.

General.

The College will be very pleased to advise or assist any persons who may have difficulty in using this test. Slight modification of equipment or procedure may be made from time to time, and the College will be grateful for any improvements that the experience of users of the test may suggest.

Complete testing-outfits (including benzol) and extra supplies of tested benzol can be obtained from Massey Agricultural College at the following prices: Complete outfit (including ½ gallon of benzol), 12s., plus freight; tested benzol, 8s. per ½-gallon tin, plus freight. Packages will be sent freight payable on delivery. All orders must be accompanied by a remittance for the necessary amount.

PATHOGENICITY OF THE BARK-BLOTCH ORGANISM.

EXPERIMENTAL WORK ON LEMON-TREES.

R. M. BRIEN, Mycological Laboratory, Plant Research Station, Palmerston North.

BARK-BLOTCH (*Ascochyta corticola*) was first recorded by McAlpine(1) from Australia in 1893 on orange-trees, and in 1899 on lemon-trees. In New Zealand it was recorded on lemon-trees in 1921 by Cunningham(2).

In 1921 bark-blotch was apparently confined to three localities near Auckland City, and until 1930 no additional locality had been recorded. In February of that year, however, it became epiphytotic in lemon-groves of the Tauranga district, in some orchards 40 to 50 per cent. of the trees being affected. In October, 1930, the disease became troublesome on one-year-old lemon-trees in an orchard in the Gisborne district, producing cankers which appeared on stems and branches contiguous to pruning cuts made two months previously. Approximately 50 per cent. of the trees in this orchard were affected, cankers appearing in 20 per cent. of the pruning-cuts.

Although McAlpine recorded that bark-blotch was due to the fungus *A. corticola*, he produced no experimental proof of the pathogenicity of this organism. Consequently, Dr. Cunningham suggested that pathological work be undertaken to ascertain whether the fungus was responsible for this disease, or merely saprophytic, following injuries induced by lemon brown-rot or the flat-headed lemon-tree borer.

With this object specimens of lemon-trees infected with bark-blotch were obtained from the Orchard Instructor, Tauranga. From this material isolations were made from (*a*) base of the trunk of a fourteen-year-old tree; (*b*) bark off base of tree thirty-five years old; (*c*) upper branch from same tree as (*b*); (*d*) lemon fruit with brown scabbed areas on cortex. Pure cultures of *A. corticola* were obtained in each case, and this material was used as a source of inoculum.

PATHOLOGICAL STUDIES.

For inoculation work six trees were procured, three each of the lemon varieties Lisbon and Eureka. These were two years old, and grafted on sweet-orange stocks. Incisions made through the cortex with a sterile scalpel were inoculated with spores of *A. corticola*, and covered for seven days with damp absorbent wool and cellophane to prevent the inoculum drying out. It was found that lesions appeared around inoculation points in from three weeks to two months. When cankers had developed, isolations were made from their margins, and in each case typical cultures of *A. corticola* were obtained.

Inoculations in lemon fruit and leaves produced lesions in from twelve to fifteen days. On leaves kept under moist conditions pycnidia were produced abundantly. On lemon-fruits held under the same conditions the lesions spread rapidly, finally covering the whole fruit. Details are given in the accompanying table (next page).

Table giving Details of Inoculations.

Host.	Date of Inoculation.	Points inoculated.	Results.
No. 1 tree, var. = Eureka	22/5/30	(*a*) At side of stock ..	(*a*) After 7 months = *Negative.*
		(*b*) On stem 3 in. above stock	(*b*) After 2 months lesion 1 in. diameter, 4 months = 1 in. diameter, 6 months = 1½ in. diameter, 9 months = dormant = *Positive.*
		(*c*) On stem 9 in. above stock	(*c*) After 2 months lesion 1 in. diameter, 6 months = 3 in. diameter, 9 months 6 in. = *Positive.*
		(*d*) On branch 18 in. above stock	(*d*) After 2 months lesion ½ in. diameter, 4 months = 1 in. diameter, then merged to (*c*) = *Positive.*
No. 2 tree, var. = Lisbon	11/7/30	(*a*) At side of stock ..	No lesions developed on this tree = *Negative.*
		(*b*), (*c*), and (*d*) same as above.	
No. 3 tree, var. = Lisbon	17/9/30	(*a*) At side of stock ..	(*a*) 2 months = negative ; 4 months lesion 1 in., 6 months 4 in., penetrating half-way through trunk = *Positive.*
		(*b*) On stem 3 in. above stock	(*b*) 2 months = lesion ¼ in. diameter, 4 months = lesion ½ in. diameter, 6 months = dormant = *Positive.*
		(*c*) On stem 12 in. above stock	(*c*) 2 months = negative, 4 months = negative, 6 months = *Negative.*
No. 4 tree, var. = Lisbon	17/11/30	(*a*) At side of stock ..	(*a*) 4 months = *Negative.*
		(*b*) On stem 3 in. above stock	(*b*) 2 months = lesion ¼ in. diameter, 4 months = dormant = *Positive.*
		(*c*) On stem 12 in. above stock	(*c*) 2 months = lesion ¼ in. diameter, 4 months = dormant = *Positive.*
No. 5 tree, var. = Eureka	17/11/30	(*a*) At side of stock ..	(*a*) 4 months = *Negative.*
		(*b*) 3 in. above stock ..	(*b*) 2 months lesion ¼ in. diameter, 4 months lesion 1 in. diameter = *Positive.*
		(*c*) 12 in. above stock ..	(*c*) 2 months lesion ½ in. diameter, 4 months lesion 1½ in. diameter = *Positive.*
No. 6 tree, var. = Eureka	..	Not inoculated. Remained healthy.	

Symptoms produced.

Cunningham(3) considered that the disease was confined to branches and stems, and gave details of symptoms produced on these. The symptoms described below are those appearing on inoculated two-year-old lemon-trees grown on sweet-orange stocks. The appearance of a dark-brown zone at the point of inoculation indicates infection. This area gradually extends around the point of inoculation until the stem or branch becomes girdled, when all portions above turn yellow and die, the leaves ultimately falling away. The lesion enlarges downwards, gradually encircling and killing the lower branches. Gumming usually accompanies infection, but does not occur until two or three weeks after inoculation. When cankers are from four to six months old, greyish-white patches appear in which are embedded the numerous black pycnidia of the causal organism. On young trees the disease may be detected readily, the brown lesion contrasting with the green stem ; and in later stages of infection, when stem or branch becomes ringbarked, wilting and premature falling of leaves is a conspicuous feature.

Cultural Studies.

Ascochyta corticola is readily isolated from the margin of cankers on stem or branch. Tissue taken from this region was plated on prune dextrose agar, and after four to six days' incubation at 21° C. hyphæ of the fungus were secured and transferred to standard potato dextrose agar and sterilized lupin stems.

Prune agar, an acid medium of P.H. 6·1–6·3, has been found very satisfactory in this Laboratory for the primary isolation of fungi from plant material; for if bacterial contaminations are present the fungus outgrows them, enabling clean transfers to be made to potato dextrose

FIG. 1 (LEFT). CANKERS PRODUCED TWO MONTHS AFTER INOCULATION. × ½.

FIG. 2. LATER STAGE OF INFECTION ON SAME TREE, SHOWING BRANCH KILLED BY THE FUNGUS. LOWER MARGIN OF CANKER INDICATED BY WHITE LINE. × ½. [*Photos by H. Drake.*

agar. On Prune agar *A. corticola* produces sparse mycelial growth, but rarely forms pycnidia. On potato dextrose agar (P.H. 6·4–6·6) this organism makes abundant vegetative growth, but does not readily produce fructifications. The mycelium at first is white all

over, changing in two to three months' time to light brown, and finally to dark brown. The mycelial mat is depressed flocculent at the centre to tomentose at the periphery and distinctly zoned. The colony-margin is uneven and occasionally lobed. On this medium pycnidia

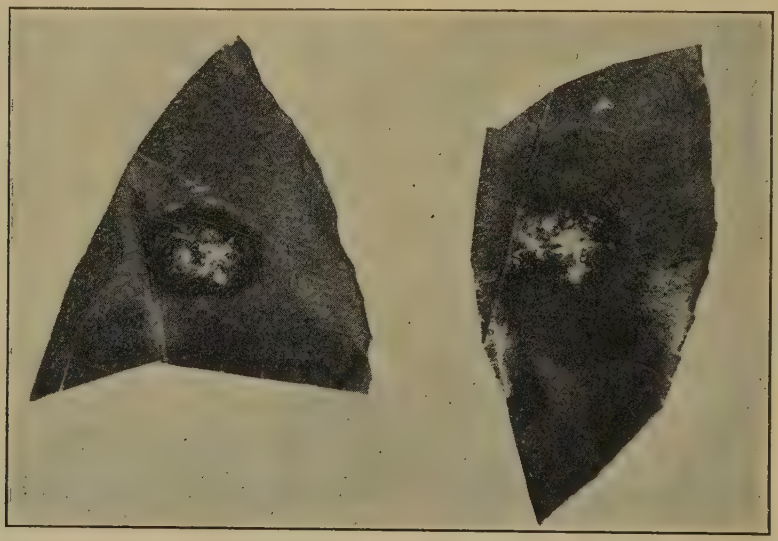


FIG. 3. LESIONS ON INOCULATED LEMON LEAVES, SHOWING PYCNIDIA. × 1.
[*Photo by H. Drake.*

FIG. 4. LESION ON INOCULATED LEMON FRUIT. × 1.
[*Photo by H. Drake.*

do not appear until from four to six weeks, and then only in small numbers. The optimum temperature for growth was found to lie between 21° and 25° C. On sterilized lupin stems scanty mycelial

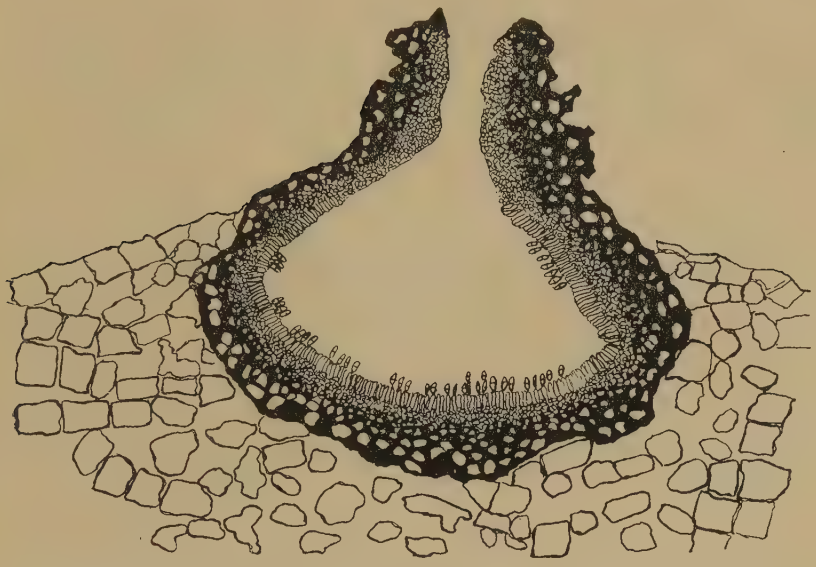


FIG. 5. SECTION OF PYCNIDIUM ON LEAF. × 500.
[*Original.*

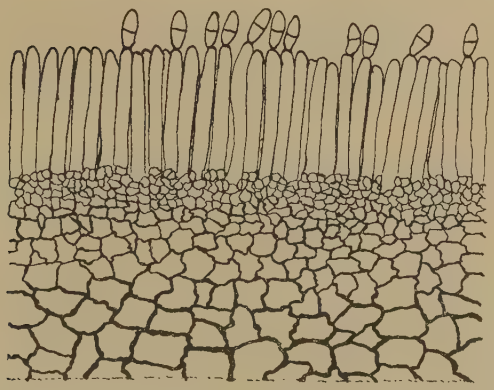


FIG. 6. SECTION OF PYCNIDIAL WALL, SHOWING CONIDIOPHORES AND SPORES.
× 1,000. [*Original.*

growth is produced, but pycnidia are formed in profusion after ten to fifteen days. Under the moist conditions prevailing in lupin-stem cultures pycnidia swell rapidly and release their spore tendrils. By using this medium an abundance of spores was secured, and all material for inoculation work was prepared in this way.

Morphology.

In conjunction with the foregoing work a morphological study of *A. corticola* has been undertaken. Microtome sections of pycnidia on lemon-leaves (secured as a result of artificial inoculation) were prepared by the paraffin process, and from these the following emended description has been drawn :—

Ascochyta corticola, McAlpine.

" Fungous Diseases of Citrus Trees in Australia." pp. 110–111, 1899.

Pycnidia erumpent, depressed-globose to lenticular, dark brown to black in transmitted light, wall complete, plectenchymatous variable in size, 300–375 microns ; ostiolum papillate, 15–18 microns diameter.

Spores 2-celled, hyaline, elliptical, frequently allantoid, not constricted at the septum, smooth, 7–9 × 2–3, average 7·7 × 2·8 microns. Conidiophores simple, continuous, cylindrical, 12–14 × 3–3·5 microns.

Hosts : (1) *Citrus medica.* Linn. var. *limonum* ; on branches, stems, leaves, and fruit.

Distribution : Australia—Lancaster ; Ardmona ; Victoria ; (McAlp.). New Zealand—Auckland ; Tauranga ; Gisborne.

(2) *Citrus aurantium* Linn., on wood and stems.

Distribution : Australia—Lancaster ; Victoria ; (McAlp.).

Remedial Treatment.

In " Fungous Diseases of Fruit-trees," p. 322, Cunningham recommended the removal of infected tissues around cankers, disinfection of these with a solution of acidulated mercuric chloride* ; and finally painting over the wounds with coal-tar. Latterly he has recommended as an alternative treating wounds with bordeaux paste*. The former treatment when applied to infected trees in the Tauranga district in 1930 gave complete control. The latter, when applied after the outbreak on young trees in Gisborne, also proved successful, completely arresting the disease where 50 per cent. of the trees were infected.

Conclusions.

The results of these experiments show that under optimum conditions *A. corticola* is a definite wound parasite on stems, branches, leaves, and fruit of the lemon-tree. Infection may become established through injuries and the lesions remain dormant until conditions are favourable, when further development proceeds. During January and February, usually our two hottest months, cankers on inoculated trees spread rapidly at the rate of 2 in. a month. At Tauranga the disease developed extensively during the same period. Two varieties only were used in the work here described—Lisbon and Eureka. Cankers were formed on both varieties, but to a lesser extent on the Lisbon. On the sweet-orange stocks only one inoculation proved positive, being the only record in New Zealand of *A. corticola* attacking this host.

The writer wishes to thank Mr. L. M. Estcourt, Orchard Instructor, Thames, for supplying material of bark-blotch, Mr. P. Everett, Orchard Instructor, Gisborne, for information regarding the disease there, and Mr. H. Drake for preparing the photographs.

* The preparation of acidulated mercuric chloride and bordeaux paste are given respectively on p. 36 and p. 73 in " Fungous Diseases of Fruit-trees."

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(2) CUNNINGHAM, G. H. Bark-blotch, *Ascochyta corticola* McAlpine, A Disease of Lemon-trees. *N.Z. Fruitgrower*, Vol. 4, pp. 134–135, 1921.
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IMPORTATION OF FERTILIZERS IN 1930–31.

R. E. R. GRIMMETT and J. A. BRUCE, Chemistry Section, Department of Agriculture.

IN examining the figures for the importation of fertilizers during the year ended 31st March, 1931, compiled from quarterly returns furnished by courtesy of the Comptroller of Customs, the first point revealed is the marked decrease in most of the principal items as compared with 1929–30, the peak year of this trade. Doubtless the all-round reduction is chiefly attributable to the prevailing economic depression.

Phosphatic fertilizers amounting to 247,000 tons were imported last year, compared with 346,000 tons for the previous twelve-month. The chief decrease is to be found in the North African—Moroccan and Tunisian*—rock phosphates. Egyptian phosphate, sold under the well-known brand of "Ephos," at one time a popular manure, is now practically off the market, none having been brought into the Dominion during the past year. Of rock phosphates from the Pacific, deliveries from Nauru and Ocean Islands show a substantial drop. A slight increase over the preceding year is shown in the case of supplies of phosphate rock from other phosphate-bearing islands in the Pacific. Facilities, however, for loading phosphate at Nauru Island have recently been greatly improved by the installation of a cantilever wharf, which is now in commission, and is stated to be capable of loading a 7,000-ton steamer in twenty-four hours. The importation of basic slag has also declined considerably. Of the total, a small amount—some 6,000 tons, mainly 15-per-cent. "open hearth" slag—was drawn from Great Britain, the remainder being the higher-grade "Bessemer" product from European sources, notably Belgium.

The falling-off in the quantity of potassic fertilizers—supplied to us by France and Germany—has been much less marked than in the case of the phosphatic class. The demand, however, for the former class of fertilizer in the Dominion is still comparatively small.

In the nitrogenous group a very noticeable decrease has occurred in the importation of Chilian nitrate of soda, doubtless due to its large replacement on our market by sulphate of ammonia, the price of which has fallen in consequence of mass production. Though the figures for sulphate of ammonia indicate a considerable shrinkage, the importations of this product are still very much greater than in the year 1928–29.

Sulphate of iron is included as a fertilizer in importation returns, but it is not recognized under the Fertilizers Act. Only 2 tons

* Mined in Tunis and ground in Belgium.

came into the Dominion during the year under review, as against 63 tons in the previous year. This may to some extent be accounted for by the fact that this material is now made by fertilizer-manufacturers in Auckland for soil-amendment purposes.

The unspecified fertilizers include the highly concentrated preparations, diammoniumphosphate, urea, Nitrophoska, &c., made by the I.G. Farbenindustries at their works, Leuna and Oppau, Germany. It would appear that these compounds have not yet emerged from the experimental stage as far as their use in New Zealand is concerned.

TABLE 1.—SUMMARY OF FERTILIZER IMPORTATIONS, 1930–31 AND 1929–30.

Fertilizer.	Quantity.		Declared Value	
	Year 1930–31.	Year 1929–30.	Year 1930–31.	Year 1929–30.
	Tons.	Tons.	£	£
Bonedust and bone-char ..	795	1,420	6,964	11,854
Basic slag	67,766	94,332	189,091	273,190
Superphosphate	..	525	..	1,309
Nauru/Ocean Islands phosphate ..	119,478	136,410	141,090	169,077
Island phosphate (other)* ..	37,472	34,587	61,652	46,390
Egyptian phosphate	..	1,000	..	3,415
Moroccan phosphate	8,038	35,348	10,919	49,090
North African phosphate (other) ..	250	37,424	505	94,020
Phosphate (not otherwise specified)	13,405	4,805	33,708	11,135
Kainit	997	839	2,752	2,270
Muriate of potash	50	28	394	188
Sulphate of potash	1,310	1,106	13,631	11,273
Potash salts (other)	5,833	6,217	26,161	31,178
Sulphate of ammonia	6,170	11,015	58,510	119,202
Nitrate of soda	754	2,263	7,628	22,442
Cyanamide (nitrolim)	30	97	255	828
Sulphate of iron	2	63	20	469
Fertilizers unspecified	92	1,283	1,180	17,073
	262,442	368,762	554,460	864,367

* For details see Table 3.

NOTE.—The values shown in the above table are those declared for Customs purposes and represent the current domestic values in the countries of exportation, plus 10 per cent.

TABLE 2.—IMPORTS OF THE PRINCIPAL PHOSPHATIC FERTILIZERS, 1922–31.

Year ended 31st March,	Bonedust.	Basic Slag.	Super-phosphate.	Pacific and Indian Oceans Phosphate.	Egyptian Phosphate.	Moroccan Phosphate.	North African Phosphate (other).
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1922 ..	4,063	13,488	3,140	45,956	..	..	..
1923 ..	2,446	19,641	..	69,591	..	..	..
1924 ..	4,158	39,632	255	76,517	5,996	..	..
1925 ..	2,452	45,682	10	108,163	8,530	..	..
1926 ..	2,085	44,314	500	97,488	10,037	..	..
1927 ..	1,805	53,327	15	161,541	5,979	..	..
1928 ..	725	48,913	6,616	143,373	6,603	13,389	..
1929 ..	554	93,222	1,037	178,057	6,000	22,173	12,499
1930 ..	1,420	94,332	525	170,997	1,000	35,348	37,424
1931 ..	795	67,766	..	156,950	..	8,038	250

TABLE 3.—IMPORTATION (IN TONS) OF PRINCIPAL ARTIFICIAL FERTILIZERS FOR YEAR 1930–31, SHOWING COUNTRIES OF ORIGIN AND NEW ZEALAND PORTS OF ENTRY.

New Zealand Port of Entry.	Chile.	India.	Pacific and Indian Oceans Islands.		Britain.			Belgium.			France.			Germany.		Tunis.	Morocco.	Netherlands.
	Nitrate of Soda.	Bonedust.	Name.	Phosphate.	Phosphate.	Sulphate of Ammonia.	Basic Slag.	Phosphate.	Basic Slag.	Potash.	Phosphate.	Basic Slag.	Potash.	Basic Slag.	Potash.	Phosphate.	Phosphate.	Phosphate.
Auckland	754	680	Nauru/Ocean	57,256	21	2,610	2,563	7,463	25,554	40	50	660	1,495	11,685	2,641	..	4,930	700
			Seychelles ..	4,131														
			Tuamotu ..	8,758														
New Plymouth	..	..	Nauru/Ocean	12,896	30	900	1,725	756	12,818	..	..	..	323	865	570	..	1,375	..
Wanganui	..	..	Nauru/Ocean	17,655	..	..	..	..	..	..	..	..	..	..	..	..	1,733	..
			Seychelles ..	1,560														
Napier	..	..	..	..	..	41	..	..	..	..	..	..	10	..	5	..	..	..
Wellington	..	75	..	..	50	475	1,650	445	3,160	..	..	..	293	1,305	513	..	..	..
Nelson	..	..	..	..	25	225	35	350	1,100	..	..	..	115	265	172	..	..	..
Lyttelton	..	20	Nauru/Ocean	13,983	..	625	..	50	205	..	..	..	70	..	223	..	..	..
			Tuamoto ..	7,297														
Timaru	..	..	..	..	50	200	25	200	70	..	..	..	25	30	83	..	..	200
Dunedin	..	20	Nauru/Ocean	16,968	..	594	..	580	220	..	..	..	205	300	247	..	..	..
			Seychelles ..	3,445														
			Tuamotu ..	4,346														
Invercargill	..	..	Seychelles ..	7,915	1,210	500	125	1,045	2,631	..	..	..	745	775	440	250	..	200

SEASONAL NOTES.

THE FARM.

The Pastures.

FARMERS should now proceed as rapidly as possible with any harrowing and top-dressing that remains to be done before the arrival of the dormant season of grassland. Manures applied when a soil is so cold that grass-growth has practically ceased for the time being will have little or no effect until greater soil-warmth returns. Just when it is too cold to effectively apply manures is controlled by geographical position : in the coastal districts they may be applied with good effect later than in colder, interior situations, and later generally in the North Island than in the South Island.

Each farmer has to decide according to his circumstances the date in early winter beyond which it is inadvisable to top-dress his grassland. Generally any top-dressing remaining to be done after the date fixed upon may well be postponed until the spring. An exception to this would arise when pressure of other spring work would interfere, in which case top-dressing done during the dormant season of pastures would probably be more profitable than if postponed until very late in the spring. Prospective feed-supplies have some bearing on the date at which top-dressing should be done ; the farmer who is faced with the likelihood of being short of feed in winter and early spring is in greater need of autumn top-dressing.

The first and principal necessity in regard to top-dressing in New Zealand is generally the application of phosphates. Despite much unofficial advice to the contrary, phosphates, as a rule, give the greatest and most immediate profits. There are exceptions to this rule, but a farmer should make sure that his case is really an exception before ignoring the rule in his practice. Attention to the rule means simply that phosphates should have first call on any funds available for top-dressing. At times other materials may be profitable, but when only a limited amount of money is available the use of such materials would be justifiable only on the belief that they would give a greater profit for each £1 of expenditure than would phosphates, or that phosphates have been used in sufficient quantities to meet the full economic needs of the position. Field results show that for the majority of farms such belief would not be sound.

To sum up, frequently the best top-dressing investment is money spent on phosphates alone ; sometimes in top-dressing it is advisable to supplement phosphates by other materials, but seldom, if ever, is it advisable to use such materials except in conjunction with phosphates. In brief, phosphates hold the key position in New Zealand top-dressing, and scarcity of finance intensifies the dominance of phosphates. It is surely fortunate that, while phosphatic manures are the most important, they are also the cheapest of the fertilizing-materials.

Seasonal Ensilage Considerations.

On many farms during the relatively slack winter months the provision of ensilage pits or trenches might profitably receive attention, particularly as it is work which as a rule is better done well ahead of the time when ensilage operations are being carried out, in order to allow of the thorough settling-down of the earth disturbed in the construction work.

Where the pit or trench system of ensilage can be adopted it usually should be utilized, because it minimizes the amount of wastage and is economical in its labour and equipment requirements. Unfortunately, suitable sites for pits or trenches are not to be found on all farms. In

selecting a site it is necessary to ensure, firstly, that it is conveniently situated both for harvesting and feeding. This usually means that a pit should not be placed at one corner of a large field. Further, labour is saved if the pit is situated on a bank or terrace, so that the green material is pitched in from the top and the cured material loaded out from the lower side of the pit. This necessitates the possibility of a good roadway for carting out from the lower side. The pit should not be subject to invasion by water either because the water-level of the location is near the surface or because there is seepage from a higher level. Pits calling for special drainage measures have little to recommend them, and should, if possible, be avoided. The assumption that a satisfactory pit or trench demands a terrace of considerable height is quite unfounded; really efficient results have been obtained in trenches approximately 4 ft. in depth.

Farmers may obtain detailed information about pits or trenches suited to their requirements by applying to the officers of the Fields Division in their respective districts.

Feeding Silage to Sheep.

It is probable that this winter an increased number of farmers will be feeding silage to sheep. Sheep, being naturally nervous, usually do not consume silage readily when it is first offered to them, and they may leave it untouched because of its strangeness unless their curiosity is so stimulated by the pangs of hunger that they are induced to nibble at it and so become acquainted with it. Hence, when it is desired to feed sheep on silage for the first time, it is usually necessary for some days to make no other food available to them until they have commenced eating the silage. If, however, the sheep to be fed include some which have previously eaten silage, these will set an example which the others will most likely soon follow, and so will remove the difficulty of initiating the feeding of the silage. Because of the possibility that it will be necessary to partially starve sheep to which it is desired to introduce silage, it is highly advisable to commence feeding the sheep before they have become low in condition, for if they are not called upon to depend upon silage until low in condition the partial starvation period which it might then be necessary for them to undergo would give them an undesirable setback which might be reflected detrimentally in the wool. In past experience, when sheep have been partially starved to induce them to commence eating silage, they have been in relatively good condition and no harm to the wool has resulted. On the basis of this knowledge it is as well to make safety the objective, and to introduce silage early, while the sheep are in relatively good condition, even if it is necessary subsequently to leave off feeding silage for an interval.

Farm-drainage.

Apart from low-lying waterlogged soils which are obviously in a badly drained condition, there are in New Zealand thousands of acres of retentive heavy soils which would give very profitable returns from money spent on drainage. In general, winter proves the most suitable season in which to attend to farm-drainage. Possibly the first point that generally needs to be realized is that money may easily be wasted on drainage—even on that of land requiring drainage—unless the work is planned and carried out in an intelligent and careful manner. Only a short outline of some matters at times inefficiently dealt with is here possible. It seems to be overlooked frequently that the drainage of wet spots in a field is generally the most profitable type of drainage a farmer can undertake. As a rule the first few pounds spent on drainage return the greatest percentage of profit. In the drainage of isolated wet spots an endeavour should be made —particularly if tile drains are being employed—to locate the drain-lines in such a way that the drains would serve as part of any more comprehensive future work, and probably be the basis of it.

In planning a drainage system the first thing that should be studied is the source of the excessive supply of water. Such study may reveal the possibility of draining an area by preventing water reaching it, rather than by removing water after it has reached the area. Wet areas along hillsides or at the foot of hills often offer opportunity for the use of drains placed to intercept water in its passage to badly drained land. Drainage by interception, as this method has been called, is frequently much less costly than any other equally effective means of drainage.

Mole drainage, because of its relatively low cost, will be utilized with profit in the future over much greater areas than any other form of drainage. The cost of mole ploughing ranges from about 10s. to 25s. per acre, according to the circumstances of individual farms. The cost should be in the vicinity of the lower figure on farms equipped with their own tractors. To be fully effective the expenditure on mole ploughing usually requires to be supplemented by other expenditure, principally in tile drainage, which will be mentioned later. But fortunately when both sets of expenditure—that on mole ploughing and that on tile drainage—have been combined, they represent a relatively small annual charge when the number of years of usefulness of drainage well carried out is kept in mind.

Formation of Mole Drains.

The following guidance in regard to the actual work of providing mole drainage is based on information supplied by Mr. W. J. McCulloch, Fields Superintendent:—

No definite rules can be laid down as to the depth and the space between lines of mole drains. A useful general rule as to depth is to place the mole drains in the subsoil, but not any deeper than is necessary to ensure that the comparatively crumbly surface soil will be avoided. If the moles are not below this more open, relatively crumbly layer their period of usefulness will be greatly reduced, whereas if they are deeper in a heavy subsoil than is necessary they will bring about correspondingly slower drainage—a distinct disadvantage. Further, it is well to keep in mind that the depth of moles should be determined not by the average thickness of the more open surface layer, but by its greatest thickness. If this rule were not observed the mole drain would collapse, after a relatively short period, in those parts of it that passed through surface soil where the layers of it happened to be deepest. After this happened at least a part of the drainage system would function inefficiently. Mole drains are usually suitably placed at a depth of from 17 in. to 20 in. The distance between lines of mole drains that give efficient results is determined by the nature of the soil. The heavier the land the closer should be the drains. Usually on land that calls for mole drains it is not advisable to place the mole farther apart than 9 ft., and often better and more profitable results would follow were the moles 6 ft. rather than 9 ft. apart on the more tenacious clays.

Apart altogether from the outlets of moles, which will be discussed later, it is frequently advisable to supplement mole drains with lines of tiles. This arises principally from the occurrence of hard-pans in the ground. These hard cemented layers, which occur at varying depths, do not allow of the formation of a proper mole by the drain-plough. The plough either rises and rides over the pan, or it penetrates it and produces rubbly material which does not give a permanent passage for the movement of water. The site of such a pan, which is indicated either by the rising of the plough, by the noise it creates, or by the struggling of the engine drawing the plough, should be carefully marked by pegs, and the portion of the mole which is affected by such a pan should be carefully tiled so as to provide a continuous passage for the flow of water.

The diameter of the plugs used on drain-ploughs is usually 2⅝ in., as good service has been obtained from moles formed by such plugs. The size of the plug decreases with wear, and possibly the plug will have become so worn after it has been used in draining 30 to 50 acres that it will be advisable to replace it.

A mole drain, like any other drain, will not function properly unless it is kept open at the mouth. If mole drains discharge through firm subsoil into open drains, it will be necessary simply to visit the mouths of the moles periodically in order to remove all material apt to hinder their discharge. When moles are placed to discharge along a natural hillside or terrace the position is not so simple. In this case the openings will usually be in soil or crumbly subsoil which will continually obstruct discharge of water unless proper measures are adopted. One means of dealing with this position is to dig a trench at the mouth of each mole drain until solid subsoil is reached, and then to lay tiles from this point to the point of original discharge and fill in the trench. It is not sufficient merely to lay a tile or two at the opening in the subsoil and to have the mole discharging into an open trench, for the latter would soon be blocked by trampling of stock.

When the lower ends of a series of mole drains are along a slope, another and probably more economical means of ensuring efficient discharge is to provide an intercepting tile drain which suitably crosses all the moles in solid subsoil, and which provides for the discharge of all water from the moles at a single point. Unless the outlets of mole drains occur along a gully or stream it is standard practice to intercept their discharge by a tile drain functioning in a similar way to the one just mentioned. When tile drains are to be utilized in this way the tiles should be placed at a depth which will allow the mouths of the mole drains to discharge at the same level as the top of the tiles. It is preferable to form the mole drains before the ditches for the tile drains have been opened, but the opening-up of the ditches for the intercepting tiles should be done as soon as possible after the forming of the mole drains. By avoiding delay in this connection one eliminates the danger of clay and silt particles collecting in any depressions in the mole drain in the vicinity of where the tile drain crosses it When the intercepting tiles are being laid it is highly advisable to establish a connection between the mole drain and the tiles by placing a grass sod against the sides of the open ditch immediately above the mouth of the mole and across to the tile.

Mole drains 8 to 10 chains long as a rule give good service, and they may safely be made longer, provided there is a good and uniform fall throughout their length. Mole drains are not adapted for use on extremely level ground, but they function satisfactorily provided there is a fall of 3 in. to 4 in. to 100 ft., and so they seldom need be ruled out on account of lack of fall. It is not advisable to establish mole drains on a steep grade, for too rapid flow of water would cause the sides of the mole to scour away, and this would lead eventually to the collapse of the drain. In mole drains it is particularly advisable to avoid the occurrence of level sections or of depressions, for these introduce the danger of gradual silting and eventual blocking of the drains. Hence it is well to remember that the fall of the drain follows the contour of the surface of the land, and so it is necessary to go round instead of across depressions. The principle that water will siphon across a hollow is unsound for practical guidance in this matter, because it omits the vital danger of the blocking of the drain by fine deposit.

The formation of mole drains is usually best done in early winter, after the first heavy rains have well moistened the subsoil. If the subsoil is too dry when the plough passes through it the plug exerts a breaking effect, the walls of the drain are cracked, and this is likely to lead to

eventual blocking of the drains. On the other hand, if the subsoil is too wet the result is a glazed wall in the mole drain, and this means slower passage of the water from the soil into the drain.

When cost of drainage is of particular importance mole drains instead of tile drains may be run across a series of mole drains to intercept the discharge of the latter. The intercepting mole drain must be formed with care, it should be larger in diameter than the mole drains which it intercepts, and it should be at such a depth that, while it is slightly below the others, it connects with them. A 3 in. plug may be taken as the maximum. If one intercepting mole drain formed by a 3 in. plug is insufficient, several such drains or ones made with the 2⅝ in. plug may be used.

In next month's notes some points at times overlooked in connection with tile drainage will be discussed briefly.

Crop-utilization.

On many farms the pulling and storing of mangels may suitably be done at this season, and this is especially so if the land occupied by the mangels is to be sown fairly soon with a crop such as oats. If, as may happen in some of the milder districts, the mangels are still obviously growing, there is nothing to be gained by pulling them straightway unless the land is required, or unless it will be difficult to do the work later either because of the wet condition of the ground or because of pressure of other work. In any case, it is well to remember that pulling usually hastens the maturing of the roots, and thus, particularly when it is desired to use the crop somewhat early in the season, it should be pulled in good time to allow of proper maturing of the roots.

The references to crop production and utilization which appeared in last month's notes cover generally the matters which will require attention during May and June.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Winter Activities.

FROM now on the energies and activities of commercial fruitgrowers should be directed towards rendering their orchards free from over-wintering pests and diseases, and improving the general condition of the trees and soil, in preparation for the best possible start at the commencement of next season. The dormant season may be estimated as approximately four months, during which time manuring, pruning, spraying, cultivation, drainage, and orchard hygiene generally should receive close and studied attention.

Manuring.

The following points should be considered prior to investing in manures: Firstly, a mental analysis of the class of fruit produced during the past season—*inter alia*, the colour of the fruit, the size of the fruit, and the quantity of the crop. In conjunction with these aspects the vigour and annual extension of growth made by each variety should be checked up *in the field* and carefully noted. Having done this, the grower is in position to discriminate regarding the fertilizers required. Assuming that the trees are deficient in annual wood-growth, and that the fruit produced was small, the foliage scanty, and not characteristic of a tree in vigorous health, the major portion of the money invested in the purchase of manures for the next season should be spent on nitrogenous fertilizers.

In distinction to this recommendation, where trees are making more annual growth than is useful or desirable, resulting in large, soft fruit, below the colour requirements of high quality, the use of nitrogenous manures should be very limited, if not entirely cut out, and the expenditure on fertilizers confined to phosphatic and potassic manures. The writer's experience has been that generous dressings of burnt lime will in most cases expeditiously correct the undesirable conditions often brought about by excessive applications of nitrogen, especially on clay lands.

With regard to the selection of manures several factors should be considered: Firstly, the history of the manurial treatments previously applied; secondly, the class of soil; and, thirdly, the average rainfall. These factors will influence to a considerable extent the result which may be experienced from subsequent applications of fertilizers. For instance, if nitrogen is required, select nitrate of soda, which is alkaline, or dried blood, which may be regarded as neutral, to counteract any acid conditions induced by previous applications of sulphate of ammonia; or, *vice versa*, select sulphate of ammonia to extend the stimulating action of nitrate of soda and counteract the detrimental effects which such manure may have had on the mechanical condition of the soil.

The manurial programme invariably needs adjustments each year to meet the varying conditions which arise each season, and unless the commercial fruitgrower can understand the effects of individual manures it is strongly recommended that a complete and well-balanced fertilizer be selected. For use on deciduous fruit-trees a well-proportioned manure would be represented by the following mixture for 1 ton: 14½ cwt. superphosphate, 1 cwt. sulphate of ammonia, 2½ cwt. sulphate of potash, and 2 cwt. bonedust. A manure so constituted contains all the elements of plant-food and will remove from the mind of the user any anxiety regarding the failure to supply or supplement a deficiency which may exist in the soil.

Pruning.

With little extension of commercial planting in the Dominion, it seems unnecessary to stress the importance of hard pruning in the early stages of the trees' growth so as to obtain a strong framework capable of carrying heavy crops. The impressions of the writer are that in many instances a reduction of hard pruning on matured trees is more essential. Experience during the last two seasons has been that growers have by overhard pruning deprived themselves of legitimate crops in many cases, and the limited amount of fruit produced has been of an undesirable type—oversized and lacking in colour. The time has now arrived when orchardists will have to evolve means of producing larger crops to the acre in order to meet the reduction of monetary returns brought about by the decline in prices received for their fruit. There are two practical ways in which this can be brought about—namely, by cultivating larger trees (by pruning less severely) and by giving the trees more generous support with fertilizers. Fruitgrowers, in line with other primary producers, will have to seriously consider ways and means of increasing the production per acre.

Spraying.

Dormant-season spray applications have largely lost favour owing to the more vulnerable condition of fungi and insect pests during spring and summer months; also on the ground of expense. There are, however, cases in which autumn and mid-winter sprays are necessary in addition to those applied as late dormant or early spring sprays. The control of leaf-curl on peaches and nectarines is a case in point: certain varieties of these trees, being particularly susceptible to infection, need both autumn and spring applications of spray to keep them free from infection.

Generally speaking, delayed dormant and early spring applications, followed by a consistent summer programme, will give equally as good results as can be obtained from the more costly concentrated winter formulas. For control of leaf-curl on peaches and nectarines an autumn application of bordeaux 5–4–50 or burgundy mixture will eliminate much infection which would otherwise overwinter and create infection in early spring. Burgundy mixture can be recommended as an autumn spray on account of its great penetrating and cleansing properties.

Cultivation.

The desirability of autumn ploughing must be decided by local conditions. On heavy clay lands many do not view it favourably, the effect being in most instances to waterlog the ploughed surface, increase the difficulty of getting about the orchard during the winter months, and retard spring growth by maintaining low temperatures in the soil. In most cases heavy lands left unploughed until spring will benefit by growing a valuable crop of weeds for turning under in the spring, and the condition of the ground will be suitable for ploughing a month earlier at that period. An additional drawback to autumn ploughing lies in the danger of increasing soil erosion on hillside orchards.

Orchard Hygiene.

The employment of mechanical means for the preservation of hygienic conditions in the orchard demands more time and attention than is generally devoted to the matter. The writer has in mind the thorough collection of diseased fruit from ground or tree, cutting away and destruction of over-wintering cankers, &c. This subject is dealt with at length in "Fungous Diseases of Fruit-trees in New Zealand" (Cunningham), and readers are strongly recommended to devote more time and persistence to this important phase of orchard practice.

—M. Davey, Orchard Instructor, Mapua, Nelson.

Citrus-culture.

The congenial weather conditions experienced during April resulted in trees being furnished with an abundance of new growth. This young growth is very liable to be damaged should frosts occur during the ensuing winter. With the experience of last season's frosts fresh in the minds of citrus-growers, many will be looking for some means of preventing a recurrence of badly cut trees. In those localities where frosts during some parts of the winter are common it may be advisable to use artificial means of preventing frost damage. The loss incurred from year to year from frost is very considerable. Not only are the young tender growths cut, but a good deal of the fruit is also destroyed. This is a distinct loss to the grower, and it gives the trees a setback from which it takes a considerable time to recover; moreover, what has occurred is likely to occur again.

In localities where frost is common some means should be adopted whereby the temperature can be raised a few degrees. This is only possible by using artificial heat. Several methods have been used in New Zealand that have given a measure of satisfaction. One method is to procure benzine-tins, take the top off, and then cut a vent in the bottom. Some kind of quick-kindling material is then placed in the bottom, and the top filled with coal. The tins are placed in sufficient numbers through the orchard some time before frosts are anticipated. They are covered to prevent water getting into and damping the material. When the nights are indicating a frost which is likely to do damage a torch is used for lighting them. Only about half are lit at first, and should it be necessary the remainder are lit a little later. By this means the temperature is raised just sufficiently to prevent damage.

Another method is to have pots made of fairly heavy material that will hold about 1 gallon of crude oil. Each pot is provided with a lid, by which the water is kept from the oil should it rain while the pots are in the orchard. It is also a means of extinguishing the burning oil if it is not all required during any one night. One gallon of oil will burn for several hours. A small oil torch can be procured which serves the purpose of igniting the oil in the pots. The crude oil can be procured from one of the oil companies, and costs about 6d. per gallon. The pots can be manufactured locally at about £8 per 100.

After all danger of frost is past for the season tins or pots can be stored in the shed and kept in readiness for future seasons. It is advisable to drain any unused oil from the pots and put it back into the large barrels that it is supplied in. The empty pots would then stack up into a very small space. Alternatively, the tins could be taken in just as they are and stacked up in a dry shed for the following year.

The cost of either operation is not great in comparison with what the loss may be should a succession of sharp frosts occur. (Full particulars of frost-prevention for orchards have been given in special articles in past issues of the *Journal*.)

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Overhauling Incubators and Brooders.

Now that the breeding-season is approaching the poultry-keeper's time should be taken up mainly in having everything in readiness for when the busy time arrives. The incubators and brooders should be carefully examined, and special care taken to see that they are in thorough working-order. It may be found that fresh burners for incubator-lamps are required, new connecting-rods for the machines where the old ones have been bent, or new set-screws to replace those which have become worn and are liable to cause a serious accident at any time.

Management of the Breeding-birds.

The late-moulting hens previously selected for this season's breeding-pens having passed through the moult, it is important that from now onward they be carefully fed and managed in order that they may come to the breeding-season with the vigour so necessary for the production of healthy stock. In the first place, it is a mistake to let these birds get too fat, and while it is true that the high-type layer, when in a laying-condition, cannot be overfed on a proper egg-producing food, it is possible to make a bird overfat and in an undesirable breeding-condition when she is on a diet such as that which is suitable for breeding-birds. Only a small amount of forcing ingredients should be included, and rich foods, such as meat or its substitutes, should therefore be sparingly supplied.

It should be remembered that very often poor fertility and the production of chickens that cannot be reared result from fat hens or from their being provided with a rich ration. This is not to say that the birds should be placed on what might be termed a starvation ration, but rather that they should be well fed but not overfed. The aim should be to keep them in a healthy lean condition just before and during the time when they are producing eggs for hatching purposes.

It will generally be found that better fertility and stronger chicks will result from feeding the breeding-birds a whole-grain ration, such as a mixture of equal parts of wheat, oats, and maize, no mash mixture being supplied.

The greater the variety of ingredients included in the ration for breeding-birds the better will be the results from the hatching and rearing operations, and also in the quality of the stock reared. Of course, nothing can take the place of free range for breeding-birds, by which a great variety of food and natural exercise is made available to them. When the birds are kept confined abundant scratching-material should be provided, in which the birds should be made to work for practically every grain of food they receive. This will prove an excellent means of inducing exercise, which is essential for maintaining birds in a proper breeding-condition.

In the feeding and management of breeding-pens many lessons can be taken from birds that live under natural conditions and are not interfered with by man. It will be found that the great majority of birds under natural conditions commence their breeding operations after the most lean period of the year, the winter, when foods are most scarce. In addition to this, the work of making their nests tends towards preventing an accumulation of body-fat. It is an old saying, and no doubt a true one, that nature's methods cannot be improved upon; so that if vigorous progeny are to be secured from our fowls the natural methods must be copied as closely as possible in all things pertaining to breeding.

The Time to Mate.

In order to obtain pullets to commence laying in the month of April, light breeds should be hatched during September and the heavy breeds a month earlier. Naturally, some strains mature earlier than others, and this should be allowed for. Where it is desired to secure a good egg-yield in the autumn of next year, the breeding-pens should be mated up during the coming month. This will give the birds an opportunity of being in a condition to enable chicks to be hatched out in July. As the great majority of the adult birds in the average flock will not be laying at this period of the year, and in order to secure July-hatched chicks, the poultry-keeper will be forced to use pullet eggs for incubation. Breeding from pullets is not generally recommended, but for the production of early autumn eggs an exception must be made. When using pullets for breeding special care should be taken to see that they are well developed (bred from hens the previous season and not from pullets) and possessed of strong points which indicate constitutional vigour, such as bright prominent eyes, well-developed crop, tight feathering, and generally an active businesslike appearance. When pullets are bred from they should be mated, where possible, with an adult male. Breeding from cockerels and pullets should be avoided wherever possible.

Importance of the Male.

In the mating of stock the male bird plays an important part, for he is more than half the flock. He should, above all things, possess signs of undoubted constitution and utility character, while in addition he should have every opportunity of maintaining himself in the best possible condition. Faulty condition of the male is a common cause of infertile eggs and weak germs being produced.

Breeding males should be frequently handled when on the perch at night, and when a bird is found to be out of condition the only safe course is to have him replaced by another. On all plants there should be spare breeding males in case of accident or sickness taking place. In the case of male birds of the lighter breeds which carry a heavy or drooping comb and long wattles, there is the question as to the advisability of removing both the latter. The comb is often a burden for a bird to carry, while the wattles prevent it from picking up its grain to the best advantage, especially when fed in long grass or deep litter, and as a result its health

and general condition become impaired. As a result of removing the comb and wattles, when these are more or less abnormal, a bird will usually feed better and produce a greater number of fertile eggs and strong chicks. By means of a pair of sharp scissors the operation can be simply performed. In order to prevent bleeding a good dressing of fuller's earth or iodoform should be applied to the cut parts.

When a male has to be taken out of the breeding-pen on account of going off in condition it is a mistake to put him by himself. He will eat better, be more contented, and regain his breeding-condition more quickly if given the company of one or two hens.

It goes without saying that if breeding-birds are to do their best they must be free from insect vermin. For ridding birds of these pests there is nothing better than the Black Leaf 40 treatment which has been referred to in previous issues of the *Journal*.

Internal Parasites.

With the egg-yielding capacity of fowls being steadily increased and the consequent heavy tax which is being made on the reproductive organs, it naturally follows that the demand on their vigour and the risk of the birds being attacked by disease and internal parasitic life—worms and coccidiosis—are also correspondingly increased. It is safe to say that at the present time parasitic infestation is giving more trouble in poultry flocks than ever before. If these troubles are to be kept in check, or prevented, the only sound means is to breed stock of such vigour and to manage them in such a way as to increase their power of resistance. In this connection one cannot urge too strongly the importance of having an area of clean ground during the following season to accommodate the young stock right through their growing-stage. No stock do so well as those that are reared on fresh clean soil—in fact, it is impossible for chickens to make sound development if the only run provided is where adult hens have recently had access.

To be forewarned is to be forearmed, and therefore poultry-keepers in general would be well advised to pay greater attention to seeing that all stock mated possess undoubted constitutional vigour and that their progeny are given every opportunity to make sound development by good feeding, clean houses, and, above all, fresh clean ground on which to run.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Provision of Winter Stores.

THE losses attendant upon starvation are no less serious a menace to the beekeeper than disease. While disease is met with from time to time, each autumn brings the problem of wintering the bees, and, while the professional apiarist will prepare his colonies so as to guard against serious losses, the average beekeeper is apt to overlook the essentials that make for success. There are factors, such as shelter, watertight hives, vigorous young queens, &c., which all play a part in the wintering problem; but, above all, a supply of food sufficient to meet the colonies' want must not be overlooked. The safe wintering of bees is a test of a beekeeper's capabilities, as he is called upon to gauge the amount of stores required to tide his bees over the period between the autumn flow and the appearance of the early nectar-secreting plants. Locality plays an important part, more especially where autumn flows are unknown and fine autumn weather prevails. In these districts the consumption of stores is greater, and a constant watch must be kept on the hives so as to determine the amount of food required to guard against loss, as breeding will be carried on until a later period in the season.

Various estimates have been given as to the amount of food required to winter the cluster—varying from 30 lb. to 40 lb.—and experience has proved that, providing a colony is left with this amount, it will not only winter well but will build up rapidly in the spring. In any case, it is by far the safest policy to leave an excess of food rather than run the risk of leaving the colony short and with barely enough to tide it over the dormant period. Where the amount of stores is less than 30 lb. the shortage can be made up quickly by the insertion of a few combs of honey. Calculating on the basis that a full comb contains 6 lb. of honey, it is easy to estimate the weight of honey in the hive.

Feeding and Feeders.

If combs are not available, feeding should be undertaken. This latter operation should not be delayed till the cold weather, but commenced early in autumn. For supplementing the stores sugar syrup, fed in the proportion of two of sugar and one of water, is the best substitute for honey. Avoid using inferior qualities of sugar. None but the best white sugar should be fed. In feeding to augment the winter food-supply it is often necessary to give large quantities of syrup, and consequently large feeders must be adopted.

The Miller and the division-board feeders are excellent for this purpose. The former enables about 10 lb. to 25 lb. of stores to be fed at one time. It is designed to be placed inside the super or upper story on top of the brood-frames, and has two compartments for syrup, the passage-way for the bees being in the centre through the bottom, directly over the cluster. The division-board feeder is popular, and enables about 5 pints of syrup to be fed. Hanging between the frames, all that is necessary is to turn back the mat so that the opening in the top is exposed. The main advantage of this feeder is that food can be supplied without exposing the cluster and without the aid of smoke.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Storage of Produce.

For nearly six months there is comparatively little growth outside, and this necessitates storing sufficient fresh fruit and vegetables of many kinds to supply demand during this interval until new crops mature in the spring. Successful storage is sometimes very profitable. The conditions necessary for successful operations of this kind have always been of interest owing to their great importance. Each class, kind, and variety of produce has its peculiarities which must be considered in this relation. Some have no keeping-qualities whatever—except when bottled, canned, or dried.

Produce that experience has proved to have keeping-qualities should be carefully examined before storage. It is very common to find that owing to careless grading a proportion—perhaps small—of diseased and injured specimens are mixed in. This unfortunate oversight might add a little weight at the beginning of the season, but it is generally the cause of heavy loss when the disease spreads; regrading has to be done and the balance put up for immediate sale. Mixed stocks, even of good keeping kinds, should be closely watched, and sold early before they make a loss.

The place and conditions of storage must be clean and suitable if the produce is to be attractive towards the close of the storage period. It is

not that a few cobwebs or a little dust is going to do any harm, but buildings used for storing produce are often found infected with diseases and pests that are harmful—fungus spores, cocoons and eggs, especially when rejected material lies about the floor or in the vicinity. It is not uncommon to find produce that was at first undoubtedly sound infected and spoiled during storage. It would pay well to give attention immediately at the close of the storage season to all buildings used for such purposes; to thoroughly sweep them out, bury or burn the litter, and spray with a suitable wash the whole of the interior. It would then probably be biologically clean when the next storage season arrived.

Produce that is of a keeping kind and sound requires not only clean storage, but it must also be suitable. Without the resources of machinery our native Maoris had to give this subject close attention, and their methods, worked out under local conditions, often provide valuable suggestions. The method of storing sweet potatoes (kumaras) in the north is to pit them in the ground in the usual way, inside a special building. This is not given as an example to be recommended, but it is a good method of keeping this rather difficult tuber, and shows the thought and trouble given to the important work of storing food successfully for the winter and during early spring. Storing "roots" in a pit ensures a reasonably even temperature; darkness, which is often an indispensable condition; sufficient moisture to prevent shrivelling and yet not so much as to cause decay. Pitting roots is often a convenient method of storage, and effective if other things are right and the roots are allowed to sweat a bit before the soil covering is applied. But accessibility is, under some conditions, bad, especially in stormy weather. For that reason potatoes, &c., are sometimes stored in sacks or tipped into bins. The conditions must be similar to those already mentioned. They are readily found in a cellar or a building in a shady position, or a room on the shady side of a building. For long storage a concrete or earth floor assists in maintaining the desired humidity.

To store produce for a long period one requires to have a good judgment regarding its condition. Onions may be sound and of a keeping variety, and yet not suitable for long storage owing to their physiological condition, due perhaps to the season or method of growing them. A sample that is large and soft should be used up not later than the middle of the keeping period, as experience has proved that such a sample will grow or decay at the least disability. Quantities of these bulbs are wasted annually by keeping them in a humid atmosphere that suits many other kinds of vegetables. Good storage conditions for onions are thorough dryness with good ventilation.

Another important point in storing produce of this class is to remember that large stacks will sweat and heat. This is a general result of storing organic matter containing fluids. The danger is greatest for the first one or two months of storage. During that period ventilation should be given generously at suitable times and at short intervals; less will generally be required later. The danger is greatest when large stacks are built in a confined space; under such conditions heat and humidity are higher, and, owing to lack of air-space, ventilation is more difficult. Produce generally can only be built in large stacks when it is in ventilated (slatted) boxes, with an inch or so between the cases to allow the air to circulate. By attention to such details produce may often be held for a better market by avoiding the glut which usually follows the harvest.

Pruning Bush Fruits.

The prime object in pruning young plants of this class is to thoroughly furnish the whole of the available space with fruiting wood. Currants, red and white, also gooseberry-bushes, are grown on a single stem from

the ground. Black currants, raspberries, and loganberries are grown, to some extent or altogether, from suckers from the ground. In every case at the present time young bushes should be cut back to make them stool out, and so attain the prime object above mentioned—to fill the whole of the available circle of space. Cutting back young plants rather hard at this season also has an invigorating effect upon them.

Sometimes the air-space occupied by a bush is overcrowded with growth; if not all over, it may be so in certain parts. For this reason mature plants should be looked over now, and such congestion should be relieved by pruning. Otherwise those branches which are deprived of sufficient light will become barren. Raspberries and loganberries should have had their fruiting-wood and the weaker young suckers removed in summer; if that has been done there only remains now to cut away the unripened tips of the canes.

Preparing Land for July Planting.

So soon as the land is sufficiently dry—usually in the month of July—cabbage, cauliflower, onions, shallots, and sundry other plants and seeds are set out. For these crops the preparation of the land should be completed in time to allow it to settle. Keep off the land in wet weather, but make the most of the time when it is fine and dry to complete this preparation. Where slugs are likely to attack the young plants—such as lettuce—a dressing of White Island Product may be applied and harrowed in before planting; or 1 lb. finely ground sulphate of copper mixed with 20 lb. kainit and broadcasted evenly at the rate of 1 oz. to the square yard. Minute quantities of sulphate of copper in any form are peculiarly deadly to this pest.

Starting the Tomato Plot under Glass.

For planting out under glass at the end of August seeds are sown now in boxes, and raised in a warm place where a temperature of about 65° F. can be maintained. One or two features commonly overlooked are to first make sure that the seeds are of a suitable strain. No amount of attention after sowing will improve defects of this kind; on the other hand, it is most disappointing to spend time and money on seedlings that grow into barren plants or produce fruit of poor type. Another mistake is to push the plants into rapid growth by means of moisture and high temperatures. This is a very natural tendency, which is generally fatal to satisfactory cropping. Such plants are generally chilled when planted out in the unheated glasshouse. They become purple in colour, and make little or no growth for a long period. Seedlings should be grown steadily, and gradually acclimatized to the temperature of the unheated glasshouse before they are planted out. Soft plants may be chilled in a moment, but they will undoubtedly take some weeks to recover. Care in this matter is well repaid. When the young plants require water it should be given tepid.

Curing Organic Manures.

Chemical manures are extensively used, sometimes extravagantly, but generally with good results. On the other hand, organic manures, though indispensable, are tending to become scarce; and for this reason it is desirable to make the most of what is available. Organic manures are made from organic matter—that is, plant and animal refuse. Such manure is unsuitable for use until it is at least partly fermented; or, on the other hand, it is sometimes desiccated (dried) and ground to a powder. In either case it is brought to a more or less friable state, facilitating an even distribution and rapid assimilation when turned under.

A very popular means of supply is to grow a green cover-crop and plough it under when there is sufficient time and moisture to rot it in the

ground before planting the land with another crop. This is an excellent practice, especially among orchard trees, where it does not interfere with the main crop. In other cases to give up the land to green cropping for a few months is a loss to be avoided, if possible. Where it is possible to accumulate organic manures in the right condition, they should be applied and turned in at once.

Nature's wonderful economy is constantly at work on this very point. A host of insects, fungi, and bacteria are busy chopping up organic material and reducing it to a sweet fertile mould. It is merely our business to watch it to learn the principles and apply them. In heavy native bush that has not been much disturbed the process may be seen on a large scale. The main agents in fermentation are bacteria—living organisms that are very abundant in nature on plants and in the surface soil. They make little impression on living matter, but as soon as it is dead their action is rapid if the conditions are suitable. The conditions mainly are moisture and heat. Low temperatures prevent their activity, as the cold stores demonstrate; and the drying of material of this kind is another common method of preservation. To ferment waste organic matter without delay then, one must stack it together compactly, when it will quickly generate the necessary heat, and, if it is moist throughout the mass, fermentation and decay will be brought about in the shortest time.

The stack of manure of this kind accumulated during the summer has probably been used up during the autumn, and a commencement is being made to conserve future supplies as they become available. To tip it into a shapeless heap, where much of it is trodden into the ground and wasted, and generally becomes offensive, is to create a nuisance and lose valuable material. If it is chiefly stable manure containing long straw, it can be stacked in a compact manner with upright sides, and with a little care and neatness all of the conditions can be observed which will bring it to a satisfactory condition by the next autumn. Where the material is generally short and unsuitable for stacking a bin is necessary to maintain compactness. It may be of heavy timber, but brick or concrete is better. Or, again, the necessary formation may be obtained by cutting into a bank. The front is best arranged so that planks may be dropped into slots and so raised as the heap rises.

An important point to observe here is that it is not sufficient to toss material into such a stack in a perfunctory manner. It must be spread evenly and beaten or trodden firmly over the whole area, and moisture must be added where it may be considered necessary. As moisture is sometimes excessive, a concrete floor should be laid, draining into a sump. Under such conditions during the warm weather of spring and summer this material is so quickly sterilized and purified by bacterial action that there is little chance of it being offensive. As much of its value may be leached away by heavy rains, it should be covered with a roof; but a foot or so just beneath the eaves and the front should be open.

Where stock is kept the accumulation would probably have to be considerable; also in the case of a market-gardener who purchases fowl manure, &c., in a more or less fresh state. But in the smallest garden, where perhaps fowl manure, lawn-clippings, &c., will be the only available material, the method is equally good. A few inches of soil may be spread over the surface at times; it will be an excellent method of reinoculation with desirable bacteria. In this way an untidy and offensive waste will be converted into valuable material that is a necessity in the intensive cultivation of the soil.

The Homestead Garden.

When listening to an address or reading a statement on garden design and management many feel discouraged because they consider the information received is too late for application on their own property, where the

garden is already established. This is by no means the case; few gardens of any size are without some attractive features, and the rest can be remodelled, perhaps gradually, and made good. A tree or two may be removed to give a wider view; a few more planted to screen an undesirable object; a heavy plantation of ripe pine-trees gradually replaced with trees of a more varied character and less inflammable. A lawn spoiled by planting too many specimen trees and shrubs can be made a wider and well-proportioned space by removing the superfluous plants to the plantations or shrubbery. Herbaceous borders that are too extensive to maintain in good order may be laid down in grass or planted with shrubs which will require little attention after they are established. Herbaceous borders which have plants placed singly at regular intervals can be replanted, and those of a kind planted in groups of a size that will be effective.

At the present time, and for the next three or four months, work of this kind can be done in fine weather with every chance of success. The result will largely depend on the time and taste devoted to the consideration of the new plans.

—*W. C. Hyde, Horticulturist, Wellington.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 26th March to 7th May, 1931, include the following of agricultural interest:—

No. 66400: Apparatus and process for drying grass; Techno-chemical Laboratories, Ltd., London, England. No. 64051: Wool-bale stacker; F. E. Bowen and A. J. Dean, Napier. No. 64119: Wool-bale cramp; J. Winders, Invercargill. No. 64752: Liquid-manure distributor; H. T. Omahuru, Auroa. No. 64784: Cheese-press; J. B. MacEwan and Co., Ltd., Wellington. No. 64903: Flexible harrow; C. Baker, Korito. No. 65333: Tine harrow; C. W. N. Sorensen, Hamilton. No. 65640: Spraying-apparatus; Scott Brothers, Ltd., Christchurch. No. 66369: Pulsator for milking-machine; F. C. Owen, Christchurch. No. 66516: Centrifugal separator; Aktiebolaget Separator, Stockholm, Sweden. No. 63633: Teat-cup inflation; A. W. Stuckey and E. G. Wilson, Morrinsville. No. 63888: Milk-cooler; W. Gordon-Jones, Punakitere. No. 64340: Egg-grading machine; R. Hamilton, Rapohe, Irish Free State. No. 66229: Butter-churn; J. O'Connell and H. H. Kerr, Kensington, Victoria. No. 66357: Milk-interceptor; W. G. Lee, Auckland. No. 66466: Dehorning and branding bail; G. G. Rountree, Dargaville. No. 66553: Milking-machine teat-cup; J. Treloar, Hamilton. No. 66554: Milking-machine indicator attachment; J. Treloar, Hamilton. No. 65532: Fencing standard and dropper; E. H. Le Gros, Sydney, N.S.W. No. 65548: Storage and transport of fruit; F. Kidd and C. West, Cambridge, England. No. 66614: Machine for scutching flax; R. S. McGaughey and Robey and Co., Ltd., Lincoln, England. No. 66674: Flue curing and drying tobacco-leaf; W. Panlook and A. J. Panlook, Eurobin, Victoria. No. 66707: Cream-cooler; E. D. Berry, Palmerston North. No. 66717: Milking-machine; J. Treloar, Hamilton.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

Suppression of Californian Thistle by Lucerne.—On a farm at Kiwitea, Manawatu, an area of loam which was badly overrun with Californian thistle was sown with lucerne. During the first year after the sowing of the lucerne the growth was dominantly thistle, but gradually the lucerne has suppressed the thistle until now, after two seasons, the thistle has so completely disappeared that it is difficult to imagine that it was so recently dominant. Regular liberal dressing of the lucerne with superphosphate following an application of lime when it was sown has probably much to do with the success of the lucerne.—*Fields Division.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

FEIJOA FOR HEDGE IN THE NORTH.

"SHANDON," Arkles Bay, Whangaparaoa :—

Can you inform me if the feijoa of South America could be grown with any success in this district ? I wish to plant it as a hedge if so, and would like to know where I can obtain plants.

The Horticulture Division :—

There is little doubt about growing the feijoa at Whangaparaoa successfully. It does best in a good loam rich in humus, and planted about 3 ft. apart it forms an attractive hedge. If it is required to bear fruit the hedge should not be too dense, and pruning must be done with discretion. Plants may be obtained from Mr. H. R. Wright's nurseries, Avondale, Auckland.

DESTROYING HOP-VINE ROOTS.

W. NEWLING, Mount Maunganui :—

Can you explain how to destroy hop-vine roots ? We have them in one corner of our bowling-green on the bank. The roots and vines spread along the top of the ground, so we are unable to mow the bank with a lawn-mower.

The Horticulture Division :—

The position you describe is very extraordinary and not easy to imagine. If hop-vines on a bank of a bowling-green spread along the top of the ground, so that you are unable to mow the bank with a lawn-mower, probably you will be best advised to dig them out ; then repair the bank, finishing off by neatly turfing it. If the turf is laid towards the end of July, it should be well established before the bowling-season commences.

PRUNING TREATMENT FOR QUINCE-TREES, ETC.

"MONTE CARLO," Richmond :—

(1) I have some quince-trees which, as the soil is good, grow vigorously, so are pruned yearly, and I guess are forty years old. Each year the fruit grows smaller and fewer, also with more black-spot and ripe-rot. They are the old-fashioned Portugal quince. Would cutting down and regrafting be advisable ; and, if so, what sort would you recommend ? (2) What month is the best for pruning New Zealand native small trees—Pittosporum, hoherias, &c. ; also for semi-deciduous trees—Gaya Lyalli, fuschia, &c. ? (3) When is the best time to sow in the open Monte Carlo palm seeds ? I am told they do not transplant well. When young should they be protected from frost ?

The Horticulture Division :—

(1) Quince-trees forty years old and growing vigorously are almost sure to be receiving wrong pruning treatment. Open up the crowded portions of the tree at winter pruning, doing as little shortening as possible. In January summer-prune the trees. This policy will steady the growth and induce a more fruitful habit. Portugal quince is of superior quality, but does not bear freely ; its seedling Van Diemen is generally better in that respect. (2) The best month for pruning New Zealand native small trees is about the month of August, shortly before growth commences. (3) Seeds of Monte Carlo palms (*Phœnix canariensis*) may be sown in the open in spring, about the month of September. A warm moist position is suitable. Plants are best removed in the warm weather, about the month of February.

NOTE.—An inquiry received from "J. H. P., Ashburton," regarding dodder in lucerne and a salt-lick for sheep, cannot be answered unless full name is supplied.

WEATHER RECORDS: APRIL, 1931.

Dominion Meteorological Office.

General Notes.

Though the weather for the greater part of the month was fine and mild, with an absence of strong winds, there were three stormy periods in April, and a fourth was commencing at the end of the month. Two of these storms were of unusual severity.

Temperatures were again below normal. In the North Island the departures were mainly slight, but in the South Island they were considerable. There was a prevalence of southerly winds, and widespread frosts occurred, though, except in the south, they were not severe. Most of the heavier rainfalls were accompanied by mild temperatures; in most districts there has been a rapid growth of grass, and stock are in good condition. It is only from parts of South Canterbury and Otago, where the dry and cold weather has been unfavourable to stock and pastures, that adverse reports have been received.

Over the greater part of the North Island the rainfall was considerably above normal, but deficiencies occurred in the extreme North, in parts of the Thames, Coromandel, and western Bay of Plenty districts, and about Hawke's Bay and Poverty Bay. In the South Island, Golden Bay, Marlborough, and the extreme northern part of Canterbury had considerably above the average; but over the remainder, low rainfalls were experienced, especially in Otago and South Canterbury.

The first of the storms referred to occurred on the 2nd and 3rd. A deep and complicated depression moved from the Tasman Sea on to New Zealand. The variation in pressure in front of it was very rapid, and consequently conditions favoured strong northerly winds. Actually these reached gale force over a wide area extending from the extreme north to beyond Christchurch. About Cook Strait the most severe northerly gale for many years was recorded. Rain was practically general, but in the Tararua Mountains and where the ranges of northern Nelson and Marlborough faced the wind directly the falls were of unprecedented magnitude. Unfortunately, the total fall was registered at few stations, owing to the gauges overflowing or being washed away. Some of the total registrations for the 2nd and 3rd were over 8·75 in. at Collingwood, over 24·05 in. at Bainham, 16·84 in. at Karamea, 10·21 in. at Millerton, 15·15 in. at Tiroroa, 11·17 in. at Otira, and 13·55 in. at Yncyca Bay in the Marlborough Sounds. Record floods occurred in the Hutt and Otaki Rivers, due to the rain in the mountains. At Nelson and New Plymouth extraordinary high tides occurred on the morning of the 3rd. Much damage was done and two lives lost. An interesting phenomenon was the accumulation of foam on the coast of Westland; in places it was heaped as high as 8 ft.

The second stormy period in the month occurred between the 7th and the 11th. Between the 7th and the 10th a series of cyclone centres crossed New Zealand, the tracks taken being progressively more northerly. Many heavy rainfalls were recorded in the North Island. The period culminated in gales on the 11th as the depressions moved away eastward. In the far North, the gales were from the west, but in the central and southern portions of the Dominion they were southerly. At Wellington the southerly was only slightly less severe than the northerly of the preceding week. The rain on the 10th and 11th was particularly heavy in the coastal portions of Marlborough and North Canterbury, many totals exceeding 5 in. This storm was followed by a period of southerly winds, which continued until the 15th. Cold weather was experienced, with frosts at many places.

On the 18th another depression moved on to the Dominion, and a cyclone centre located in its northern portion passed between Cape Maria van Diemen and Norfolk Island on the 19th. Though the winds associated with this disturbance were not very strong, it was responsible for some very heavy rains, especially in the northern and western districts of the North Island. A spell of southerly weather followed this storm also.

On the 30th general rain was caused by a depression which was approaching from the Tasman Sea, and the month closed with stormy conditions prevailing.

RAINFALL FOR APRIL, 1931, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	3·94	16	1·46	4·36
2	Russell	5·39	12	2·24	3·91
3	Whangarei	5·96	16	2·22	4·82
4	Auckland	8·99	14	3·57	3·48
5	Hamilton	5·05	11	1·61	3·86
6	Rotorua	7·14	10	1·80	4·43
7	Kawhia	7·70	16	4·07	4·59
8	New Plymouth	7·52	13	1·57	4·50
9	Riversdale, Inglewood ..	11·76	13	2·22	8·02
10	Whangamomona	6·78	9	1·63	6·50
11	Eltham	6·18	13	1·17	5·15
12	Tairua	5·38	13	1·26	6·35
13	Tauranga	4·32	11	1·41	4·74
14	Maraehako Station, Opotiki	8·02	14	2·10	4·59
15	Gisborne	1·12	13	0·20	4·14
16	Taupo	3·59	12	0·88	3·64
17	Napier	2·14	14	0·81	2·82
18	Hastings	2·76	13	1·18	3·38
19	Taihape	3·45	12	1·26	2·88
20	Masterton	3·79	16	0·94	3·03
21	Patea	5·44	15	1·12	3·57
22	Wanganui	3·30	7	1·05	3·28
23	Foxton	4·85	11	1·10	2·37
24	Wellington (Karori Reservoir)	5·35	14	1·60	3·89
	South Island.				
25	Westport	5·95	11	3·15	8·25
26	Greymouth	8·17	10	2·96	8·46
27	Hokitika	7·42	9	3·16	9·42
28	Ross	8·95	10	3·46	12·53
29	Arthur's Pass	14·77	3	8·05	16·58
30	Okura	12·47	8	4·21	14·59
31	Collingwood	13·60*	12	*	7·77
32	Nelson	2·48	10	0·65	2·96
33	Spring Creek	4·07	10	1·12	1·99
34	Tophouse	7·84	9	2·86	4·67
35	Hanmer Springs	6·25	10	4·34	2·89
36	Highfield, Waiau	5·81	4	5·15	2·62
37	Gore Bay	7·97	6	6·44	1·91
38	Christchurch	0·91	9	0·45	1·91
39	Timaru	0·64	7	0·26	1·55
40	Lambrook Station, Fairlie ..	1·20	5	0·38	1·98
41	Benmore Station, Clearburn	1·11	8	0·35	2·66
42	Oamaru	0·45	7	0·16	1·80
43	Queenstown	2·42	6	0·63	3·05
44	Clyde	0·65	5	0·20	1·48
45	Dunedin	1·95	12	0·35	2·80
46	Wendon	1·07	11	0·35	2·94
47	Gore	1·33	15	0·19	3·12
48	Invercargill	1·58	16	0·52	4·28
49	Puysegur Point	6·74	20	1·34	7·99
50	Half-moon Bay	3·20	17	0·67	5·49

* Gauge overflowed on 2nd.

—Edward Kidson, Director of Meteorological Services, Wellington, 6/5/31.

FERTILIZER IMPORTATIONS: MARCH QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 31st March, 1931 :—

Sulphate of Ammonia : United Kingdom, 425 tons. *Basic slag :* United Kingdom, 4,186 tons; Belgium, 28,221 tons; France, 650 tons; Germany, 9,331 tons. *Guano :* Seychelles Island, 6,570 tons. *Rock phosphates :* Ocean Island, 6,832 tons; Nauru Island, 20,475 tons; Tuamotu Archipelago, 12,512 tons. *Phosphates (other) :* United Kingdom, 50 tons; Belgium, 5,183 tons; Netherlands, 200 tons. *Kainit :* France, 25 tons; Germany, 163 tons. *Muriate of potash :* France, 10 tons. *Sulphate of potash :* France, 35 tons; Germany, 116 tons. *Potash (other) :* France, 200 tons; Germany, 255 tons.

RESTRICTIONS ON IMPORTATION OF POULTRY.

NEW regulations governing the importation of poultry into New Zealand were gazetted on 30th April and came into force on that date. The regulations prohibit, save with the consent of the Minister of Agriculture, the importation of any live poultry (including domestic fowls, ducks, geese, and turkeys) from any country, unless—

(*a*) Each consignment is accompanied by a certificate dated not more than one month before the exportation of the poultry to which it relates and signed—(i) In the case of poultry intended for introduction from any State in the Commonwealth of Australia, by a responsible officer of the Government of the State of export certifying that he has examined the poultry to which such certificate relates and found them healthy and free from disease, that Pseudo-fowl Pest (or Newcastle Disease) has not existed in that State during a period of two years immediately preceding the date of the certificate, that the poultry are the product of that State, and that they have not been in contact with any poultry affected with Pseudo-fowl Pest (or Newcastle Disease) during the period of twelve months immediately preceding the date of such certificate; or (ii) In the case of poultry intended for introduction from any country other than the Commonwealth of Australia, by a responsible officer of the Government of the country of export or other person approved by the Minister of Agriculture, certifying that he has examined the poultry to which such certificate relates and found them healthy and free from disease, that Fowl Pest (*Pestis gallinarum*) and Pseudo-fowl Pest (or Newcastle Disease) have not existed in that country during a period of two years immediately preceding the date of the certificate, that the poultry are the product of that country, and that they have not been in contact with any poultry affected with Fowl Pest (*Pestis gallinarum*) or Pseudo-fowl Pest (or Newcastle Disease) during a period of twelve months immediately preceding the date of such certificate; and

(*b*) Every such certificate is produced at the port of landing to an Inspector under the Stock Act, 1908; and

(*c*) A permit for the poultry to be landed is issued by such Inspector upon being satisfied that the certificate is in order and that it relates to the consignment of poultry intended to be introduced, and that the poultry are healthy and free from disease.

FORTHCOMING WINTER SHOWS.

Waikato Winter Show Association: Hamilton, 26th May to 3rd June.
Otago A. and P. Society: Dunedin, 2nd to 5th June.
Taumarunui Winter Show Association: Taumarunui, 4th to 6th June.
Manawatu A. and P. Association: Palmerston North, 16th to 20th June.
South Taranaki Winter Show Company: Hawera, 30th June to 4th July.
Auckland Winter Exhibition: Auckland, 8th to 18th July.
Canterbury A. and P. Association: Christchurch, 8th to 22nd August.